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16. Abstract

The aerodynamic data that were derived in 1967 from the analysis of flight-generated data for the Gemini entry module are presented. These data represent the aerodynamic characteristics exhibited by the vehicle during the entry portion of Gemini II, III, V, VIII, X, XI, and XII missions. For the Gemini V, VIII, X, XI, and XII missions, the flight-generated lift-to-drag ratios and corresponding angles of attack are compared with the wind tunnel data. These comparisons show that the flight-generated lift-to-drag ratios are consistently lower than were anticipated from the wind tunnel data. Numerous data uncertainties are cited that provide an insight into the problems that are related to an analysis of flight data developed from instrumentation systems, the primary functions of which are other than the evaluation of flight aerodynamic performance.

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SUMMARY ANALYSIS OF THE GEMINI

ENTRY AERODYNAMICS

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SUMMARY ANALYSIS OF THE GEMINI

ENTRY AERODYNAMICS

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SUMMARY

A presentation of the aerodynamic data derived in 1967 from the analysis of flight data for the Gemini entry module is made. These data represent the aerodynamic characteristics exhibited by the vehicle during the entry portion of Gemini V, VIII, X, XI, and XII missions. The entry vehicle configuration, entry modes, flight data sources, data uncertainties, and aerodynamic analysis method are discussed.

The resultant values for the normal-force coefficients are of questionable reliability as a result of accelerometer uncertainties. The necessity of using an assumed axial-force coefficient (derived from wind tunnel data) in an analytical determination of air density precluded the determination of this coefficient from the flight data. Apparently, the angle-of-attack data are accurate to $\pm 1.0°$. Although the lift-to-drag ratio is not affected as severely by the various uncertainties as are the force coefficients, a comparison with the wind tunnel data indicates that the flight-generated lift-to-drag ratios were consistently lower than were expected. This effect, in part, results from instrumentation uncertainties that affect the accurate determination of the normal-force coefficient.

INTRODUCTION

The purposes of the Gemini Program were to insert a two-man spacecraft into a semipermanent orbit around the earth, to study man's ability to rendezvous and dock with another orbiting vehicle, and to demonstrate a subsequent safe return of the spacecraft and its occupants to the earth. Eleven entry flights of the two-man Gemini vehicle were conducted during the period from April 8, 1964, through November 15, 1966.

One of the specific objectives of the Gemini Program was the development of the controlled entry techniques that are required for landing in a predicted touchdown area. The planned entry modes and the maneuver control program were based on anticipated spacecraft aerodynamic response as formulated from the results of wind tunnel tests. Subsequent flight results and poor targeting success indicated that inaccuracies existed in the aerodynamic data derived from these tests. To facilitate improved target accuracy and to further develop wind tunnel techniques, a more accurate determination of the aerodynamic characteristics of the entry vehicle was attempted by means of a study

of the flight data and additional wind tunnel tests. This study resulted in an improved definition of the aerodynamic characteristics of the Gemini vehicle and in improved techniques for the analysis of both flight data and wind tunnel data. These improved techniques may prove to be valuable in future evaluations of this type.

The purpose of this report is to document the calculated aerodynamic data derived in 1967 for the seven Gemini flights from which adequate flight data were available. These data are presented in tabular form. A description of the Gemini entry vehicle and its entry modes; the origin, availability, and reliability of the flight data; a description of the analysis technique; and a comparison with wind tunnel data are included.

SYMBOLS

A	accelerations, ft/sec^2
A_{NR}	resultant normal acceleration, $\sqrt{A_Z^2 + A_Y^2}$
C_A	axial-force coefficient, $\frac{-m A_X}{\bar{q}_\infty S}$
C_D	drag coefficient, $\frac{\text{drag force}}{\bar{q}_\infty S}$
c.g.	center of gravity
C_L	lift coefficient, $\frac{\text{lift force}}{\bar{q}_\infty S}$
C_N	normal-force coefficient, $\frac{-m A_Z}{\bar{q}_\infty S}$
C_{NR}	resultant normal-force coefficient, $\sqrt{C_N^2 + C_Y^2}$
C_Y	side-force coefficient, $\frac{m A_Y}{\bar{q}_\infty S}$
d	maximum body diameter, feet
h	altitude, feet

L/D	lift-to-drag ratio, C_L/C_D
M	Mach number
m	spacecraft mass, slugs
$\bar{q}$	dynamic pressure, lb/ft^2
$\bar{q}_{MAX}$	maximum dynamic pressure, lb/ft^2
Re	Reynolds number based on d
Re_{2D}	Reynolds number behind the normal shock based on d
S	aerodynamic reference area, ft^2
$T-T_R$	elapsed time since retrofire, seconds
T_R	time of retrofire, seconds
T_{C2B}	transformation matrix relating corrected inertial platform axis system to body axis system
T_{I2P}	transformation matrix relating earth-centered inertial axis system to misalined inertial platform axis system
T_{G2I}	transformation matrix relating geodetic axis system to earth-centered inertial axis system
T_{P2C}	transformation matrix relating misalined inertial platform system to corrected inertial platform system
u, v, w	X, Y, Z body axis components of freestream velocity, ft/sec
V	velocity, ft/sec
V_E	earth relative velocity, ft/sec
V_E (G)	earth relative velocity in the geodetic axis system, ft/sec
W	spacecraft weight, pounds
X, Y, Z	axes of an orthogonal reference system
α	angle of attack, degrees (fig. 1)

α_T	total angle of attack, degrees (fig. 1)
β	sideslip angle, degrees (fig. 1)
γ	flight path angle, degrees
ϑ	longitude angle, degrees
Θ	pitch gimbal angle, degrees
ρ	air density, slugs/ft^3
σ	spacecraft azimuth as measured in a clockwise direction from true north, degrees
ϕ	roll gimbal angle, degrees
ϕ_A	aerodynamic roll angle, degrees (fig. 1)
ψ	yaw gimbal angle, degrees

Subscripts

A, N	relates to spacecraft body force components
B	relates to the spacecraft body reference system
C	relates to the corrected inertial platform reference system
G	relates to the geodetic reference system
I	relates to either inertial measurement unit or body-mounted accelerometer data
P	relates to misalined inertial platform reference system
X, Y, Z	relates to axes of an orthogonal reference system
∞	relates to freestream conditions

GEMINI ENTRY MODULE

The Gemini spacecraft consists of two major structural assemblies: the entry module and the adapter (ref. 1). The adapter consists of the equipment and retrorocket sections and joins the entry module to the launch vehicle. The adapter contains the primary oxygen supply, the retrograde rockets, and the major components of the electrical,

propulsion, and cooling systems. Because the equipment section is jettisoned before the time of retrofire (T_R) and because the retrorocket section is separated from the entry module after retrofire, the adapter does not influence the entry aerodynamics, as is discussed in this report.

The entry module (fig. 2) is shaped like a frustum of a cone with a slightly tapered cylindrical extension projecting from the smaller end. The length is 151.88 inches (fig. 3) and the maximum diameter is 90.00 inches. The diameter of the forward (smaller) end is 32.30 inches. The weight of the module is approximately 4800 pounds.

The three primary sections of the entry module are the rendezvous and recovery (R and R) section, the atmospheric entry control system (formerly known as the re-entry control system (RCS)) section, and the cabin section. The entry module also includes the heat shield and nose fairing and has no protuberances that significantly affect the entry aerodynamics.

Rendezvous and Recovery Section

The R and R section forms the forward part of the entry module and is attached at its base to the entry control system section. The R and R section is shaped like a tapered cylinder and has an external surface of beryllium shingles that cover an internal structure of titanium alloy.

The R and R section houses the rendezvous radar equipment, the docking system (on spacecraft 8 to 12), and the parachute landing system. This section is separated from the entry control system section by a pyrotechnic device at the signal for drogue-parachute deployment.

Entry Control System Section

The entry control system section is located between and joined to the R and R and cabin sections. It is cylindrical in shape and consists of a titanium alloy primary structure that is covered by eight beryllium shingles.

The entry control system section houses the fuel and oxidizer tanks, valves, tube assemblies, and thrust-chamber assemblies for the entry control system. The section is equipped with a parachute-adapter assembly on its forward face for attachment of the main parachute.

Cabin Section

The cabin section is shaped like a frustum of a cone. It is joined at its small end to the entry control system section and at its base to the adapter assembly. The cabin pressure vessel is constructed of welded titanium framework, sidepanels, and bulkheads. The outer conical surface is covered with René 41 beaded shingles for heat protection, and the large-diameter end is protected by the heat shield. Three equipment bays are provided in the space between the pressure vessel and the outer shell. The

inertial measurement unit (IMU), which provides the onboard flight data, is located in the left equipment bay. Access to the cabin pressure vessel is provided by two structural hatches.

The cabin section provides a hospitable environment for the crew and a central control for the various spacecraft systems. Housed within this section are the following spacecraft systems or major portions thereof: environmental control, communications, guidance and control, instrumentation and recording, sequence, and scientific experiments. In addition, the cabin contains necessary components of the electrical system, the cooling system, the pyrotechnics system, and so forth. The cabin section is equipped with survival equipment, emergency escape mechanisms, aft parachute bridle, and a hoist loop.

Heat Shield

The Gemini heat shield is a 90-inch-diameter segment of a 144-inch-radius sphere. The ablative heat shield consists of a phenolic honeycomb core filled with an ablative silicone elastomer. This shield is bonded to an unfilled honeycomb substructure that is attached to a titanium support ring. The entire assembly is encircled by a fiber edge-ring adapter and is bolted to the large end of the cabin section.

Nose Fairing

The nose fairing is a cylindrical, fiber-glass-laminate cover that is attached to the forward end of the R and R section. The fairing is jettisoned during launch just before spacecraft separation.

ENTRY MODES

The Gemini spacecraft is maneuvered in space by the use of an orbital attitude and maneuver system located in the equipment-adapter section. This system is used to place the spacecraft in retrograde position (fig. 4) in preparation for the entry sequence. Then, the entry control system onboard the entry module is activated and the equipment-adapter section is separated from the entry vehicle. Next, the retrorockets are fired sequentially, after which the retrorocket-adapter section is jettisoned from the entry module. Then, the vehicle is rolled into a predesignated entry attitude.

The Gemini entry module is provided with the capability of controlling the entry trajectory (ref. 2). The asymmetric center of gravity (c.g.) trims the module aerodynamically at an angle of attack α that provides a lift vector for maneuvering (fig. 5). Maximum lift in a vertical geodetic plane is obtained by holding a zero-bank attitude throughout the entry. By rolling the module continuously at a constant rate, the lift vector is rotated continuously around the flight path to produce a net lift of zero that results in a ballistic-type entry. A 90°-bank-angle attitude also produces zero lift in the vertical geodetic plane. However, in this attitude, the lift vector is directed laterally with a resultant effect on crossrange targeting. Thus, by varying the bank angles

to the right or to the left, the lift vector can be used to furnish both downrange and crossrange corrections for control of the entry trajectory.

The range-control capability or touchdown "footprint" of the entry vehicle is approximately 300 nautical miles downrange and 50 to 60 nautical miles total crossrange. The greatest amount (80 percent) of range-control capability exists during the approximately 2.5 minutes that are required for the module to descend from 250 000 to 170 000 feet in altitude. Accurate control commands and accurate spacecraft response during this critical period are essential.

To demonstrate controlled entry required by the mission objectives, two different entry control methods were developed for the entry module: the zero-lifting mode and the modulated-lifting mode. For each mode, a reference trajectory guidance method is used in which the state variables along a reference entry path are precomputed, and stored values are used by the guidance program to control the spacecraft onto the nominal reference path or to establish a new trajectory to reach the target. The computer begins to provide these guidance commands in the form of required bank angles at an acceleration level of 0.03g (1.0 ft/sec^2). These computer-commanded bank angles either may be maintained manually by the pilot or automatically by the control system.

Zero-Lifting Entry Mode

The zero-lifting entry mode is based on a zero-lift (ballistic) reference trajectory. The command logic controls the spacecraft lift vector to guide the module onto a zero-lift trajectory that terminates at the target point. If no crossrange error exists, a maximum-lift attitude is maintained until the reference trajectory that coincides with the target point is reached. When the flight path of the entry module intersects the reference trajectory, a constant roll rate of 15°/sec is initiated to place the spacecraft into ballistic entry. This rolling motion is interrupted periodically to command such lift as is required to place the vehicle back onto the reference trajectory.

The command logic planned for the Gemini II, III, and IV missions was based on a zero-lift reference trajectory. On the Gemini VIII to XII missions, a command logic was used that involved a similar reference trajectory but that was improved by the addition of a Coriolis correction equation to decrease the crossrange error. The greatly improved targeting accuracy of these latter flights was attributable to the guidance logic that was designed to be relatively insensitive to the spacecraft aerodynamic coefficients.

Modulated Entry Mode

The modulated entry mode is based on a half-lift reference trajectory that terminates near the center of the range-control capability. The command logic does not attempt to maneuver the vehicle onto the reference trajectory but commands a modulated-lift trajectory that has the proper longitudinal range to reach the target. Deviations from the reference conditions are used to predict the correct constant-lift or constant-bank-angle trajectory. The magnitude of the bank angle is determined by the stored downrange capability of the module. If the downrange component of range to target is equal to the predicted half-lift range, the module maintains a constant bank

angle of 60°; if the downrange component is greater than the predicted half-lift range, a more shallow bank angle is commanded; and, if the predicted half-lift range is greater than the downrange component of range to target, a steeper bank angle is commanded. The resulting crossrange error is corrected by reversing the direction of bank when the crossrange error is equal to the crossrange capability of the module. The command logic for the Gemini V, VI, and VII missions was based on a half-lift reference trajectory.

Representative Trajectory Data

Certain entry parameters of the Gemini XII mission (which are typical of all flights) representing that portion of the trajectory from 300 000 feet to guidance termination are shown in figure 6 (the zero time line corresponds to a 300 000-foot spacecraft altitude). These parameters include dynamic pressure $\bar{q}$, flight path angle γ, Mach number M, altitude h, Reynolds number Re, Reynolds number behind the shock Re_{2D}, and roll angle ϕ_A.

The Gemini XII entry was conducted in the automatic mode using entry guidance logic. From 400 000 feet until guidance initiation, a constant 45° south bank angle was held. At approximately 18 seconds, as shown in figure 6, the computer began to command the necessary bank angle to guide the spacecraft to the target. After several minor corrections, the control system maintained a near 0° bank angle (maximum lift) from 80 to 168 seconds with a consequent decrease in the flight path angle. At 168 seconds, a constant roll rate was initiated and maintained until 215 seconds, when an additional positive downrange correction was commanded. The direction of roll was reversed at 230 seconds and again at 270 seconds to provide crossrange corrections. A slight reversal was commanded at 224 seconds to command additional downrange capability. Spacecraft guidance was terminated at 346 seconds. The perturbations in Mach number reflect changes in the entry environment (temperature).

A summary of the entry parameters for the seven flights for which the aerodynamic characteristics were computed is given in table I. The parameters include time from 400 000 feet to drogue-parachute deployment, velocity V at 400 000 feet, flight path angle at 400 000 feet, maximum load factor, and maximum dynamic pressure $\bar{q}_{MAX}$.

WIND TUNNEL DATA

The dynamic and static stability characteristics of the Gemini configuration were investigated by means of a wind tunnel test program. There were five separate phases in the development of these data. The first three phases, designated Series I, II, and III, were conducted by the hardware contractor. The fourth and fifth phases were conducted by the U.S. Air Force Arnold Engineering and Development Center (AEDC) and the NASA Ames Research Center (ARC), respectively. The Gemini wind tunnel data are contained in hardware-contractor reports and NASA documents that are not available on a general basis.

Series I Tests

The Series I tests resulted in the basic aerodynamic data for the early Gemini flights. These tests were conducted in three different wind tunnels to include the required range of flight Mach numbers. The wind tunnels used and the respective Mach number ranges tested were the McDonnell Douglas Polysonic Tunnel, 0.5 to 4.86; the Langley 11-inch Hypersonic Tunnel, 6.86 to 9.67; and the McDonnell Douglas Hypersonic Impulse Tunnel, 15, 20, and 25.

The basic hypersonic data involved large uncertainties, and the derived values were later considered questionable. Data from the McDonnell Douglas Hypersonic Impulse Tunnel had excessive scatter because of tunnel instrumentation that was inadequate to define the test Reynolds number and severe vertical vibrations of the test model as a result of starting flow shock. These data indicated the presence of a Mach number effect and the absence of a Reynolds number effect. The Series I data were improved by a comparison with the aerodynamic data of the Gemini II and III missions to produce the flight-modified wind tunnel data used in this paper for comparison.

Series II Tests

Dissatisfaction with the Series I test results led to the development of improved techniques of data acquisition and model design in the McDonnell Douglas Hypersonic Impulse Tunnel. The contractor-sponsored Series II tests were conducted to assess these improvements in tunnel capability. These tests were conducted using a 9-percent test model at a single Mach number (15) with the angle of attack ranging from 150° to 180° in 10° increments only. A range of Reynolds number per foot from 5500 to 80 000 was investigated.

Again, data scatter occurred, resulting from vertical vibration, and the analysis was complicated further by the limited angle-of-attack data. The Series II data indicated the presence of a Reynolds number effect in that the normal-force coefficient C_N and axial-force coefficient C_A did not follow expected trends.

Series III Tests

The Series III tests were initiated by the U.S. Air Force Gemini B Program. These tests were conducted in the McDonnell Douglas Hypersonic Impulse Tunnel using the same test model as was used in the previous tests (with minor alterations to the umbilical fairings). A new support system was provided to eliminate the vibration problem, and an electronic filtering system was installed to aid in the elimination of data scatter. The tests produced data for Mach numbers 15, 18, and 22 for an angle-of-attack range of 152° to 180° in 4° increments. A freestream Reynolds number per foot range of 26 700 to 143 000 was investigated. The test analysis did not indicate a Reynolds number effect, but a significant Mach number effect for the axial-force coefficient was shown.

Arnold Engineering and Development Center Tests

At the time, the Gemini spacecraft was the only lifting vehicle for which both wind tunnel and flight data were available for comparison. The contract wind tunnel operator at the AEDC recognized this comparison as a potential means of improving the AEDC wind tunnel performance and requested an opportunity to conduct Gemini tests. This request led to the testing of Gemini models at the AEDC. These tests were made in the Von Karman Gas Dynamics Facility Tunnels L and F for Mach numbers between 6.89 and 20. A Reynolds number per foot range of 26.2 to 2370 was investigated. The angles of attack ranged from 165° to 180° in 5° increments. A 6.7-percent model was used in Tunnel F and 0.5- and 0.75-inch models were used in Tunnel L.

The correlation of these data was based on a Reynolds number that would exist behind a normal shock in the test section. This method resulted in improved data in which a Reynolds number effect on the normal-force coefficient and the pitching-moment coefficient was indicated. This effect appears to become a consistent full-range trend if proper consideration is given to variations in center-of-pressure values.

Ames Research Center Tests

Freeflight tunnel data were developed for the Gemini module at the ARC. These data were obtained at a Mach number of 14, a freestream Reynolds number per foot of 96 000, and a 12 000° R stagnation temperature. The Reynolds number was varied by changes in model size. Trimmed flight at various angles of attack was provided by an offset center of gravity.

The data indicated that there is a considerable reduction in the lift-to-drag ratio (L/D) at lower Reynolds numbers for a given angle of attack. The data accuracy is questionable, especially for model sizes of 0.25 inch or smaller.

FLIGHT DATA

The basic flight data are composed of both independent measurements and analytically derived parameters that are based on the interrelationship of certain of these basic measurements. Various problems, mechanical and analytical, precluded the gathering of complete data for each of the 12 Gemini flights. The aerodynamic analysis of the Gemini entry vehicle could be conducted only for those missions from which adequate flight data were available; the reliability of the analyses, when conducted, was dependent on the relative quality of the available flight data.

Data Sources

The basic components used in evaluating the entry aerodynamics include onboard measurements, radar data, air density ρ data, and weight and balance measurements.

Onboard measurements. - Because the required data were generated during the communication blackout, the data used in this analysis were collected and stored in the onboard recorder. These data were furnished to the recorder by the onboard computer and consisted of the following information.

1. IMU accelerations A

2. Body-mounted accelerations

3. Platform gimbal angles pitch θ, roll ϕ, and yaw ψ

4. Earth relative velocity V_E

5. Flight path angle γ

6. Spacecraft azimuth σ

The recorded onboard measurements were submitted to a postflight smoothing process; the measurements were curve-fitted to provide the refined data that were used in the aerodynamic analysis. The basic measuring device for determining these data is the Gemini IMU. The IMU contains a gimbal-mounted stable platform upon which are mounted three miniature integrating gyros and three pulse integrating pendulous accelerometers. The stable platform provides a gyro-stabilized three-axis orthogonal reference system, acceleration signals generated by the three orthogonally mounted accelerometers, and angular sensor monitoring of angles between spacecraft and platform axes. Accumulated accelerometer counts for each reference axis were furnished to the onboard computer as output pulses that represent incremental velocity. These output pulses were averaged in 2.43-second cycles with a 0.1 fps read-out resolution to produce net velocity values for each time interval. The values obtained were developed by use of the computer to provide spacecraft velocity, flight path angle, and spacecraft heading. The three platform gimbal angles that represent spacecraft attitude in relation to the inertial reference frame also were furnished to the computer by the IMU.

It should be noted that the configuration of the spacecraft instrumentation that provided these onboard measurements was not planned to facilitate an aerodynamic analysis but was designed to perform the primary mission of spacecraft guidance and control. The significance of this fact will be borne out in later discussion of data accuracy and its effect on the aerodynamic analysis.

Additional onboard measurements were furnished by three body-mounted structural accelerometers. Before the Gemini V mission, the acceleration data used in the aerodynamic analyses were measured by these accelerometers.

Radar data. - Tracking stations of the NASA Manned Space Flight Network provided the necessary azimuth, range, and angular height measurements, from which the radar version of the entry trajectory was calculated. This information was used to evaluate and correct the flight-generated data (spacecraft velocity, flight path angle, and spacecraft azimuth) to construct the best estimate of trajectory (BET).

Air density data. - When possible, sounding rockets were launched in the general entry area to provide the basic measurements for determining freestream air density ρ_∞. The maximum altitude from which density was measured by these rockets was approximately 160 000 feet. Density estimates for altitudes higher than 160 000 feet were derived by means of extrapolation of the sounding rocket data.

An analytical technique, independent of sounding rocket data, was used to develop density data for some of the later Gemini flights. This method is based on onboard accelerometer sensings and the known axial coefficient as derived from wind tunnel tests.

Weight and balance measurements. - Spacecraft weight and center-of-gravity data were measured by vertical and horizontal alinement fixtures that incorporated three electronic load cells as weighing devices. These data were furnished by the spacecraft manufacturer before the flight. Inflight changes in weight and final postflight weight data were determined analytically. The postflight center-of-gravity data also were computed.

Available Flight Data

Of the basic flight parameters, onboard measurements furnished by the guidance and control system are of primary importance in the analysis method used in this report. Sufficient guidance and control data are available from the Gemini II, III, V, VIII, X, XI, and XII missions.

The Gemini I mission was a launch-vehicle test and no planned entry was conducted for this flight. The guidance and control data for Gemini II, although usable, were of less than desired quality because of timing uncertainties. An attempt to adjust these uncertainties on Gemini III data had questionable results. The Gemini IV guidance and control data were unacceptable as a result of a malfunction in the onboard computer. Similarly, an onboard tape recorder malfunction precluded the retrieval of these data for the Gemini VI, VII, and IX missions.

The other basic parameters of flight data (radar, weight and balance, and air density) are available for all flights except Gemini VIII, from which only guidance and control data and weight and balance measurements could be obtained. This mission terminated in a secondary recovery area in the western Pacific, and a consequent lack of sounding rocket measurements and adequate radar data precluded both the determination of air density data and the development of radar corrections for the best estimate of trajectory. A summary of the available flight data and the relative quality of the data recorded for each flight are given in table II.

Data Accuracy

Various uncertainties are attendant to the basic parameters that were used in the aerodynamic analysis of the Gemini flight data. An estimate of these uncertainties, their origin, and their effect (if any) on the calculation of the final aerodynamic data are discussed as follows.

Body accelerometers. - The alinement of the body accelerometers on the spacecraft is not exact and an error of 5 to 20 arc minutes is possible. The full-scale uncertainty and the telemetry (pulse-coded modulations) uncertainty of the accelerometers contribute to a potential ±1.28-percent error that is equal to ±0.2816g for the X axis and ±0.0768g for the Y or Z axes. These uncertainties had a serious effect on the determination of the body coefficients and the resultant lift-to-drag ratio for the flights (Gemini II and III) in which the body accelerometers were the primary sources of acceleration data.

Inertial measurement unit accelerometers. - The uncertainties in accelerometer measurement, as discussed in the following paragraphs, have little influence on targeting accuracy or on the performance of any other task that the IMU is designed to accomplish. However, these uncertainties introduce a significant potential error into the calculation of air density data and the normal-force coefficients, which severely hampers the determination of aerodynamic characteristics of the Gemini entry vehicle. The data measured by the IMU accelerometers are more accurate than the body accelerometer data, and there is no significant misalinement of the accelerometers relative to the stable platform. The actual acceleration sensings are accurate to ±0.04 percent; however, the resolution threshold and the method of averaging accelerometer counts produce data uncertainties that hinder the determination of the aerodynamic force coefficients.

The read-out resolution of the IMU accelerometers limits the recorded measurement of any velocity increment (representing acceleration) that is smaller than the quanitizing increment (0.1 ft/sec) divided by the time interval (2.43 seconds) over which the velocity was averaged. Thus, the minimum sensed acceleration that the accelerometers can record is 0.1 ft/sec ÷ 2.43 seconds, or 0.0412 ft/sec^2. Therefore, when the entry module first enters the atmosphere, the order of magnitude of the accelerations is such that accurate accelerometer readings are unobtainable. Because the accelerometer uncertainty is directly related to the magnitude of the sensed acceleration, the degree of uncertainty caused by read-out resolution for each of the three accelerometers is dependent on the orientation of the IMU platform with regard to the total acceleration vector. For a typical Gemini entry trajectory, the uncertainty in the measurement of the spacecraft axial acceleration at 300 000 feet is 6 to 8 percent. However, the acceleration uncertainty at the same altitude in directions normal to the spacecraft X axis can be as high as several hundred percent, depending on platform orientation and spacecraft acceleration at this point on a given entry.

The magnitude of the acceleration uncertainties resulting from read-out resolution is reduced as the acceleration increases. However, an additional accelerometer uncertainty is introduced at this point in the trajectory by data averaging. By means of the onboard computer time cycle, the IMU accelerometers provide average velocity increments for 2.43-second time intervals instead of actual point-to-point acceleration measurements. These averaged velocities are not necessarily representative of the acceleration at the end of the measured time interval, especially when the acceleration is increasing or decreasing rapidly. For a typical Gemini entry trajectory, the maximum uncertainty in axial acceleration measurements caused by data averaging is estimated to be approximately 5 percent. As the point of maximum acceleration is approached, the time rate of change of acceleration approaches zero. Therefore, at the point of maximum acceleration, the uncertainty in axial acceleration measurements

caused by averaging is zero and, because of the large magnitude of acceleration ($\approx$150 ft/sec^2), the uncertainty caused by read-out resolution is negligible. The net result is that the uncertainties in the measurement of axial accelerations become smaller at the lower end of the hypersonic range. The uncertainties caused by data averaging in acceleration measurements normal to the spacecraft X axis are influenced by platform orientation in much the same way as are the uncertainties caused by read-out resolution. Typically, low magnitude and oscillatory sensings along the Y and Z axes produce large uncertainties in these data.

The acceleration uncertainties introduce a potential 50- to 200-percent error into the determination of the normal-force coefficients for a typical entry. The apparent effect of these uncertainties on the calculation of the lift-to-drag ratio is to bias the data toward values that are somewhat lower than actually undergone by the vehicle during entry.

Because of the large uncertainties associated with the air density data provided by sounding rockets, the axial accelerations are used in conjunction with the wind tunnel derived axial-force coefficients to develop usable air density data. These data have a potential error of 6 to 12 percent as a result of the acceleration uncertainties mentioned previously.

Attitude. - The resolution of the gimbal angles by the IMU has an uncertainty of $\pm 0.004°$. This slight uncertainty has no significance in relating the stable platform to the spacecraft body. However, an uncertainty in the relationship of the stable platform to the local horizontal inertial reference system is caused by platform misalinement. This uncertainty is introduced before retrofire when the pilot attempts to aline the platform with the local horizontal. The exact value of this alinement error cannot be calculated but can only be estimated by comparing the guidance and control data with the radar data in the development of the best estimate of trajectory. An additional uncertainty is interjected at this point as a result of the inability of the best estimate of trajectory to define the altitude to less than a 3000- to 5000-foot uncertainty range. A resultant uncertainty of approximately $\pm 1.0°$ in platform alinement was estimated for Gemini missions up to Gemini IX, and an uncertainty of $\pm 0.5°$ was estimated for the remaining flights. This potential error affects the angle-of-attack calculations, introducing an uncertainty in angle of attack and sideslip that is equal to the alinement uncertainty.

Air density. - The data measured by sounding rockets up to the maximum sampled altitude of 160 000 feet have an uncertainty range of 5 to 10 percent. The uncertainty in the extrapolated data for higher altitudes was 15 to 20 percent. In addition, the sounding rocket data were not extrapolated horizontally to convert the density data from the sample area to an adjacent point on the entry trajectory. The uncertainty in the altitude, as furnished by the best estimate of trajectory, results in an additional density uncertainty of approximately 3 to 5 percent per 1000 feet of altitude error for a total additional density uncertainty of 10 to 15 percent. These potential inaccuracies in the calculation of the air density have a significant effect on the determination of reliable body coefficient data that preclude an accurate correlation with the wind tunnel data. The density uncertainties also have a significant effect on the calculation of the Reynolds number.

The alternate technique for calculating density, based on onboard accelerometer sensings and the known axial coefficients of the body, had a maximum apparent uncertainty of 6 to 12 percent, as previously discussed. This method was used on the Gemini V and succeeding flights to provide density data for the calculation of force coefficients. A shortcoming of this technique is that, because axial coefficients are assumed, only normal- and side-force coefficients (C_N and C_Y, respectively) can be determined from the analytically derived density data.

Weight and balance. - Weight data are based on preflight measurements as modified by postflight estimates of spacecraft weight loss that, in turn, is based on hardware expended, remaining consumable liquids, and so forth. The degree of uncertainty in this weight data is unknown, but it is not believed to have a significant effect on the calculation of body coefficients or the angle of attack, especially when compared to the potential air density error. The uncertainty concerning the location of the center of gravity is approximately ± 0.25 inch along the X axis of the spacecraft and ± 0.1 inch along the Y and Z axis. Although this uncertainty has no effect on the calculation of flight aerodynamics, it does hinder the correlation of flight data with wind tunnel data, making it difficult to determine if a lack of correlation is the result of poor wind tunnel data or the c.g. error. A summary of the estimated data uncertainties for the Gemini flights that have been subjected to the aerodynamic analysis is given in table III.

DATA ANALYSIS TECHNIQUE

To exercise accurate guidance control during entry, a complete understanding of the maneuver response of the spacecraft is required. This response is dependent on the aerodynamic properties exhibited by the vehicle as it passes through the upper atmosphere. A determination of these properties can be made by a data reduction program that uses complete information describing the spacecraft attitude and all forces that acted on the vehicle during the entry.

The maneuver response of the entry module is controlled by the vehicle lift-to-drag ratio. The purpose of the analysis described in this report is to compute the resultant lift-to-drag ratios that are generated by the entry vehicle at the varying angles of attack and velocities calculated for each 2.43-second increment of recorded entry data. The basic analysis technique was formulated by the Gemini hardware contractor at the request of the NASA. Modifications to this technique were made as needed during the course of the evaluation program.

Computation of Aerodynamic Angles

The aerodynamic angles (α, β, ϕ_A, and α_T) are functions of the vehicle velocity components relative to the airstream as measured in the body axis system. To compute these velocity components from the available data, it is necessary to first calculate the earth relative velocity in the geodetic axis system V_E (G). The basis for this calculation is the spacecraft relative velocity, flight path angle, and azimuth

as provided by the best estimate of trajectory. Then, the spacecraft total freestream velocity vector can be transformed from the geodetic axis system to the body axis system by a series of four transformation matrices.

The first matrix (T_{G2I}) relates the geodetic axis system to the earth-centered inertial axis system (fig. 7). This transformation is based on the spacecraft trajectory position as provided by the best estimate of trajectory. The second transformation (T_{I2P}) relates the inertial axis system to the misalined inertial platform axis system (fig. 7) and is based on recorded platform alinement data. The third transformation (T_{P2C}), relating the misalined inertial platform axis system to the corrected inertial platform axis system, is based on estimated platform misalinement data (fig. 7). The final matrix (T_{C2B}) relates the corrected inertial platform axis system to the spacecraft body axis system based on platform gimbal angle data (fig. 7).

The aerodynamic angles can then be calculated from the components of the total freestream velocity vector. The aerodynamic angle analysis program is illustrated in figure 8.

Computation of Lift-to-Drag Ratio

The lift-to-drag ratio is based on the relationship of the lift coefficient C_L to the drag coefficient C_D. These coefficients can be computed from the acceleration measurements that are provided by the IMU or the body-mounted accelerometers.

The first step in this computation is the transformation of the IMU acceleration data from the inertial platform axis system to the body axis system. Then, the force coefficients C_A, C_Y, and C_N relative to the body axes are calculated from either the IMU accelerations or the body-mounted accelerations. The resultant normal-force coefficient C_{NR} can then be determined by computing the square root of the sum of the squares of C_N and C_Y.

The coefficients of lift and drag can be calculated as functions of C_{NR}, C_A, and α_T. The resultant aerodynamic coefficients C_L and C_D, relative to the airstream, can be compared to determine the lift-to-drag ratio. A flow diagram illustrating the force coefficient analysis program is shown in figure 9.

FLIGHT-DERIVED AERODYNAMIC DATA

The aerodynamic data that were derived from the analysis of the entry flight data are presented in tables IV to X. These data include the following parameters: elapsed time since retrofire, angle of attack, yaw angle, aerodynamic roll angle, total

angle of attack, axial-force coefficient, normal-force coefficient, side-force coefficient, total lift-to-drag ratio, freestream Mach number, Reynolds number, Reynolds number behind the shock, and freestream air density.

The complete evaluation technique was not as fully developed during the analysis of the Gemini II and III data as it was for later flights. Consequently, the resultant aerodynamic parameters are less accurately defined and Reynolds numbers are not available for these two flights.

A comparison of the flight-generated aerodynamic data (L/D and and α_T) with the flight-modified wind tunnel data is presented in figures 10 to 14 for Gemini flights V, VIII, X, XI, and XII, respectively. The plotted wind tunnel data are based on the results of Series I wind tunnel tests as modified by Gemini II and III flight data.

A large amount of data scatter is present in the higher Mach number range (Mach 24 to 32). This scatter in the α_T data results from the lack of aerodynamic trim capability at lower dynamic pressures. Similar scatter in the L/D data is caused by the previously mentioned lack of trim capability combined with the effects of readout resolution and averaging on the recorded accelerometer data.

The relative smoothness of the Gemini V data (fig. 10) results from the use of a more sensitive rate-damping control mode during the entry portion of this flight. The spacecraft stabilization and control system was in the "rate-command" mode with a 0.5°/sec rate-damping deadband in pitch, roll, and yaw compared with the normally used "entry" mode that has a rate-damping deadband of 2.0°/sec in roll and 4.0°/sec in pitch and yaw.

DISCUSSION

The Gemini aerodynamic parameters presented in this report represent the best data that can be calculated from the inflight measurements. The degree of reliability that can be placed on each of the basic aerodynamic parameters (α_T, C_N, C_Y, C_A, and L/D) is dependent on the various flight data uncertainties and their influence on the aerodynamic derivations. This reliability ranges from acceptable for α_T to highly questionable for C_{NR}, discussed as follows.

Total Angle of Attack

The only important uncertainties concerning the α_T calculations are the gimbal angle uncertainty caused by platform misalinement and a potential error in flight path angle. The flight path angle uncertainty is considered to be negligible, and an analysis of the aerodynamic data indicates that the calculated α_T values are accurate to ±1.0°.

Force Coefficients

The large uncertainties associated with the air density data obtained from sounding rockets necessitated the use of analytically derived density data in the aerodynamic calculations for all Gemini flights except Gemini II and III. The use of these data precludes the determination of C_A values from the flight data. However, the C_A values derived from wind tunnel data for such blunt-nosed configurations as the Gemini vehicle have been demonstrated to be reasonably accurate, and the C_A values presented in this report are believed to be reliable.

The accuracy of C_N and C_Y calculations is greatly impaired by the large uncertainties in accelerometer data and by the 6 to 12 percent uncertainty in the calculated density data. The expectedly small normal- and side-force coefficients result in low magnitude accelerometer sensings (along the axes that describe these coefficients) that consequently fall in the range of the most significant accelerometer uncertainties resulting from read-out resolution and averaging. The resultant uncertainty in C_N and C_Y can be as high as several hundred percent, and little confidence can be placed in the C_{NR} values thus obtained.

Lift-to-Drag Ratio

The L/D is influenced by the assumed uncertainties in α_T and by the estimated accelerometer uncertainties that affect C_{NR} and C_A. However, it can be demonstrated, by placing representative values into the equation for L/D, that the total contribution of the C_{NR} uncertainty to L/D values is less than 20 percent for a worst-case situation, and this uncertainty does not necessarily result in an error of like magnitude.

By expressing the force coefficients in the equation for L/D in terms of the assumed C_A and the estimated air density equation, the equation for L/D is reduced to

$$L/D = \frac{\sin \alpha_T \pm \frac{A_{NR}}{A_X} \cos \alpha_T}{\cos \alpha_T \pm \frac{A_{NR}}{A_X} \sin \alpha_T} \tag{1}$$

from which it can be seen that L/D is not affected by the assumed C_A.

The effect of the $\pm 1.0°$ uncertainty in α_T on the calculations of L/D is approximately 10 to 15 percent. This uncertainty is biased in one direction or another for each flight depending on the trigonometric effect of the platform alinement error for the particular flight.

Comparison of Flight Data with Wind Tunnel Data

As can be noted in the comparison of flight data with wind tunnel data (figs. 10 to 14), the flight-generated L/D values are consistently lower than were anticipated by wind tunnel test results. In the data representing the Gemini XI and XII flights (figs. 13 and 14), there is substantial agreement between the flight α_T and the wind tunnel α_T, but the flight L/D is lower than the wind tunnel L/D by approximately 0.05. Although the flight α_T is somewhat higher than the wind tunnel α_T in the Gemini VIII and X comparison (figs. 11 and 12), the L/D values are in general agreement instead of being higher, as would normally be expected. The Gemini V comparison (fig. 10) shows that where the flight α_T is slightly lower than the wind tunnel α_T, the flight L/D values are correspondingly much lower.

The lack of agreement between wind tunnel α_T and flight-generated α_T for flights V, VIII, and X is apparently a result of the misalinement and c.g. uncertainties. It is believed that the effect of read-out resolution on the A_N and A_Y measurements produces consistently low C_{NR} values. The effect of this C_{NR} error is to bias the flight-generated L/D to values that are both lower than actually undergone by the spacecraft and lower than anticipated by wind tunnel tests.

CONCLUDING REMARKS

Inadequate spacecraft instrumentation and other deficiencies in data gathering techniques combined to introduce uncertainties that severely compromised the quality of the flight-derived aerodynamic data. The analysis program that was used to calculate these data was somewhat deficient in that the total effect of these potential uncertainties was not anticipated completely. Improvements in instrumentation and data gathering and a comprehensive error analysis are essential to any future program of this type if more accurate resultant data are to be obtained.

The correlation of the resultant normal-force and axial-force coefficients presented in this report with the wind tunnel data has little significance except in a qualitative aspect. The lift-to-drag data are less sensitive to the accelerometer uncertainties than are the force coefficients, and the data generally follow the same curve as the wind tunnel data. However, the accuracy of the lift-to-drag data is greatly impaired by the resultant normal-force coefficient uncertainty. The total-angle-of-attack data are considered relatively accurate and their correlation with the wind tunnel data is of a more quantitative nature.

The significance of the data contained in this report is in terms of providing reference material citing the problems and results of the subject analysis rather than of providing information of a direct or utilitarian nature. A complete cognizance of the

problems encountered in this analysis should provide the basis for improvements in systems and programing that will improve future analyses of this type.

Manned Spacecraft Center
National Aeronautics and Space Administration
Houston, Texas, November 17, 1972
951-15-00-00-72

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TABLE I. - SUMMARY OF GEMINI ENTRY PARAMETERS

Gemini mission	Time from 400 000 ft to drogue deployment, sec	Relative velocity at 400 000 ft, ft/sec	Relative flight path angle at 400 000 ft, deg	Maximum load factor, g	Maximum dynamic pressure, lb/ft^2
II	[a]414	24 302	-2.87	9.9	657
III	575	24 054	-1.05	4.3	272
V	449	24 378	-1.66	7.1	414
VIII	600	24 403	-1.30	5.4	359
X	518	24 481	-1.74	5.5	400
XI	581	24 381	-1.40	5.8	407
XII	543	24 353	-1.55	6.2	425

[a]Pilot parachute.

TABLE II. - SUMMARY OF AVAILABLE GEMINI FLIGHT DATA

Gemini mission	Guidance and control data	Attitude data	Best estimate of trajectory	Air density data
II	Fair	Fair	Fair	Fair
III	Fair	Fair	Fair	Fair
IV	None	Poor	Good	Fair
V	Good	Good	Good	Fair
VI	None	None	Good	Good
VII	None	None	Good	Good
VIII	Good	Good	None	None
IX	None	None	Good	Fair
X	Good	Good	Good	Fair
XI	Good	Good	Good	Good
XII	Good	Good	Good	Good

TABLE III. - SUMMARY OF UNCERTAINTIES ASSOCIATED WITH GEMINI FLIGHT DATA

Gemini mission	Accelerometer (body mounted), percent	Accelerometer (IMU mounted)	Attitude, deg	Altitude (BET), ft	Air density (sounding rocket), percent	Air density (analytic), percent	Location of c.g., in.		
							X axis	Y axis	Z axis
II	±1.28	Data not available	±1.0	±5 000	10 to 15	Data not available	±0.25	±0.1	±0.1
III	±1.28	Data not available	±1.0	±10 000	10 to 15	Data not available	±.25	±.1	±.1
V	±1.28	See text	±1.0	±5 000	10 to 15	6 to 10	±.25	±.1	±.1
VIII	±1.28	See text	±1.0	Unknown	No data recorded	6 to 10	±.25	±.1	±.1
X	±1.28	See text	±.5	±3 000	10 to 15	6 to 10	±.25	±.1	±.1
XI	±1.28	See text	±.5	±3 000	10 to 15	6 to 10	±.25	±.1	±.1
XII	±1.28	See text	±.5	±3 000	10 to 15	6 to 10	±.25	±.1	±.1

TABLE IV. - SUMMARY OF AERODYNAMIC DATA FOR GEMINI II

$T - T_R$, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	ρ_∞
605.2	164.09	-1.57	-5.51	164.02	-1.47	0.01	0.000	.298	25.2	2.116E-07*
607.6	165.76	2.14	8.36	165.62	-1.58	0.001	0.003	.249	24.9	2.304E-07
609.9	164.33	-0.37	-1.31	164.33	-1.54	0.004	0.008	.265	24.6	2.601E-07
612.5	163.85	3.00	10.26	163.60	-1.49	0.008	-0.054	.247	24.3	3.025E-07
614.9	164.38	-0.13	-0.45	164.38	-1.51	0.000	0.000	.249	24.0	3.364E-07
617.2	161.86	0.83	2.53	161.84	-1.49	0.007	-0.002	.320	23.7	3.721E-07
619.6	161.96	-0.33	-1.00	161.95	-1.55	0.010	0.020	.337	23.4	4.225E-07
622.0	164.45	0.23	0.84	164.44	-1.53	0.018	-0.004	.293	23.1	4.761E-07
624.5	164.92	-1.80	-6.64	164.82	-1.55	0.020	0.000	.292	22.7	5.329E-07
626.9	164.94	-2.16	-7.98	164.80	-1.58	0.016	0.010	.294	22.4	5.776E-07
629.2	164.99	0.36	1.35	164.99	-1.56	0.028	-0.036	.267	22.1	6.400E-07
631.6	165.27	1.74	6.60	165.17	-1.58	0.028	0.000	.249	21.8	7.056E-07
634.0	164.30	1.00	3.56	164.27	-1.58	0.020	-0.010	.236	21.4	7.921E-07
636.5	163.50	1.74	5.86	163.41	-1.57	0.028	-0.010	.249	21.1	8.836E-07
638.9	163.36	1.46	4.79	163.00	-1.56	0.026	0.005	.269	20.7	9.801E-07
641.2	163.01	0.74	2.41	163.00	-1.58	0.024	0.002	.289	20.2	1.081E-06
643.6	163.30	-0.35	-1.18	163.30	-1.63	0.022	0.003	.310	19.8	1.188E-06
646.0	163.97	-1.12	-3.91	163.93	-1.66	0.026	0.008	.327	19.4	1.299E-06
648.5	165.85	-0.63	-2.50	165.84	-1.69	0.026	-0.003	.289	19.1	1.440E-06
650.9	166.17	-0.04	-0.17	166.17	-1.70	0.026	-0.007	.252	18.8	1.587E-06
653.2	166.10	0.24	0.97	166.09	-1.68	0.030	0.003	.230	18.4	1.742E-06
655.6	166.00	0.72	2.88	165.98	-1.68	0.028	0.004	.213	17.9	1.932E-06
658.0	165.30	1.39	5.29	165.24	-1.69	0.030	-0.003	.212	17.5	2.161E-06
660.5	164.22	1.49	5.27	164.16	-1.70	0.030	0.001	.231	17.1	2.433E-06
662.9	163.71	0.02	0.07	163.71	-1.71	0.033	-0.003	.266	16.7	2.722E-06
665.2	164.42	-0.99	-3.53	164.39	-1.67	0.032	0.003	.285	16.3	3.097E-06
667.6	164.71	-0.70	-2.55	164.69	-1.65	0.036	-0.002	.301	15.9	3.497E-06
670.0	165.58	-1.49	-5.77	165.31	-1.63	0.034	0.002	.283	15.4	3.881E-06
672.5	166.51	-0.04	-0.18	166.51	-1.59	0.034	0.002	.245	14.7	[illegible].326E-06
674.9	166.49	-0.42	-1.75	166.48	-1.56	0.036	0.003	.225	14.3	4.796E-06
677.2	166.25	1.10	4.47	166.21	-1.59	0.038	0.005	.206	13.8	5.336E-06
679.6	165.89	1.58	6.27	165.81	-1.57	0.034	0.002	.190	13.3	5.954E-06
682.0	165.55	1.32	5.12	165.50	-1.60	0.038	0.002	.206	12.8	6.708E-06
684.5	164.83	0.89	3.29	164.81	-1.59	0.036	0.003	.225	12.3	7.728E-06
686.9	164.43	0.40	1.42	164.42	-1.60	0.042	-0.003	.240	11.4	8.940E-06
689.2	163.78	-0.71	-2.42	163.77	-1.62	0.042	0.003	.278	10.8	1.917E-05
691.6	164.33	-0.16	-0.56	164.33	-1.68	0.050	0.004	.292	10.2	1.162E-05
694.0	165.13	-1.19	-4.49	165.09	-1.67	0.044	0.033	.277	9.6	1.296E-05
696.5	167.77	-0.27	-1.24	167.76	-1.70	0.042	0.002	.242	8.9	1.436E-05
698.9	169.01	-1.62	-8.29	168.90	-1.70	0.042	-0.005	.205	8.3	1.576E-05
701.2	169.99	-0.01	-0.03	169.99	-1.71	0.042	0.004	.169	7.5	1.730E-05
703.6	170.34	1.36	7.91	170.25	-1.67	0.032	0.000	.157	7.0	1.927E-05
706.0	170.79	0.84	5.14	170.76	-1.57	0.030	-0.002	.139	6.6	2.190E-05
708.5	170.60	0.50	3.03	170.59	-1.57	0.022	-0.002	.144	6.1	2.519E-05
710.9	170.52	1.45	8.63	170.41	-1.56	0.022	0.008	.162	5.6	2.809E-05
713.2	170.10	0.78	4.44	170.07	-1.55	0.026	-0.001	.173	5.2	3.169E-05
715.6	170.53	-0.10	-0.62	170.53	-1.51	0.022	0.001	.179	4.8	3.564E-05
718.0	172.25	-0.09	-0.65	172.25	-1.57	0.014	0.002	.167	4.3	3.969E-05
720.5	171.66	-0.73	-4.98	171.63	-1.57	0.018	0.002	.168	3.9	4.408E-05
722.9	172.24	-1.00	-7.26	172.17	-1.59	0.022	-0.005	.144	3.6	4.872E-05
725.2	172.48	-0.97	-7.33	172.41	-1.59	0.018	0.004	.147	3.3	5.372E-05

* -07 INDICATES AN EXPONENT OF 10^{-7}

TABLE V. - SUMMARY OF AERODYNAMIC DATA FOR GEMINI III

$T-T_R$, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	ρ_∞
572.2	170.28	-0.08	-0.46	170.28	-1.31	0.04	0.04	.127	23.8	2.500E-07*
574.8	171.66	0.96	6.56	171.72	-1.43	0.02	0.01	.141	23.6	2.601E-07
577.0	169.86	-0.38	-2.14	169.87	-1.42	0.01	0.01	.171	23.4	2.809E-07
579.5	171.96	1.59	11.30	172.12	-1.34	0.03	0.00	.116	23.2	3.025E-07
581.8	171.08	-0.63	-4.01	171.10	-1.38	0.02	0.00	.145	23.0	3.192E-07
584.2	172.38	0.79	5.90	172.42	-1.32	0.02	0.00	.120	22.8	3.364E-07
586.7	170.63	0.13	0.76	170.63	-1.45	0.03	0.00	.139	22.6	3.600E-07
589.0	172.07	0.65	4.69	172.10	-1.48	0.03	0.03	.116	22.4	3.721E-07
591.6	171.03	2.44	15.65	171.36	-1.50	0.03	0.02	.135	22.2	3.969E-07
593.8	171.03	-1.37	-8.74	171.13	-1.43	0.02	0.01	.140	22.0	4.225E-07
596.2	171.82	1.54	10.75	171.97	-1.45	0.02	0.01	.124	21.8	4.489E-07
598.6	172.95	2.00	16.42	173.23	-1.47	0.02	0.01	.106	21.6	4.624E-07
601.0	169.83	-0.98	-5.47	169.87	-1.49	0.02	0.01	.161	21.4	4.900E-07
603.5	172.63	1.12	8.70	172.72	-1.50	0.02	0.01	.117	21.1	5.184E-07
605.7	172.88	1.92	15.56	173.14	-1.44	0.02	0.00	.109	20.9	5.476E-07
608.0	169.33	0.60	3.16	169.35	-1.46	0.02	0.02	.176	20.7	5.776E-07
610.8	173.93	-0.80	-7.56	173.98	-1.53	0.02	0.01	.091	20.4	6.084E-07
613.0	174.36	-0.80	-8.16	174.42	-1.54	0.02	0.01	.084	20.2	6.400E-07
515.4	170.84	1.65	10.26	170.98	-1.55	0.02	0.01	.147	20.0	6.724E-07
617.8	171.79	1.24	8.66	171.88	-1.61	0.02	0.02	.126	19.7	7.056E-07
620.0	171.79	0.61	4.22	171.81	-1.56	0.02	0.02	.126	19.5	7.396E-07
622.5	171.36	0.94	6.21	171.41	-1.57	0.02	0.01	.138	19.2	7.921E-07
625.0	173.92	0.18	1.74	173.92	-1.62	0.02	0.01	.092	19.0	8.281E-07
627.3	171.38	-0.86	-5.66	171.42	-1.63	0.01	0.00	.150	18.7	8.649E-07
629.8	172.11	0.23	1.69	172.12	-1.63	0.01	0.01	.128	18.4	9.216E-07
632.3	173.18	-0.55	-4.60	173.20	-1.60	0.03	0.01	.106	18.2	9.604E-07
634.5	172.13	-0.90	-6.49	172.18	-1.59	0.02	0.01	.116	17.9	1.000E-06
637.0	172.24	0.66	4.83	172.27	-1.61	0.01	0.01	.131	17.6	1.061E-06
639.3	173.37	-0.17	-1.43	173.37	-1.61	0.02	0.01	.113	17.4	1.102E-06
642.0	171.70	-0.61	-4.17	171.72	-1.62	0.03	0.01	.124	17.1	1.166E-06
644.2	173.61	0.70	6.28	173.65	-1.63	0.01	0.01	.095	16.8	1.210E-06
647.0	172.32	0.33	2.48	172.33	-1.65	0.02	0.00	.112	16.5	1.254E-06
649.0	172.80	-0.05	0.36	172.80	-1.63	0.01	0.01	.113	16.3	1.322E-06
651.4	172.62	0.46	3.52	172.64	-1.66	0.02	0.02	.108	16.0	1.368E-06
653.6	172.46	0.54	4.12	172.48	-1.65	0.02	0.01	.107	15.7	1.440E-06
656.1	173.35	1.18	10.13	173.45	-1.61	0.01	0.00	.105	15.5	1.512E-06
658.0	171.90	-1.48	-10.46	172.03	-1.64	0.02	0.01	.126	15.3	1.613E-06
661.0	172.37	-1.57	-11.83	172.53	-1.65	0.02	0.00	.112	15.0	1.664E-06
663.4	173.96	-1.63	-15.64	174.18	-1.67	0.02	0.00	.086	14.8	1.742E-06
665.6	173.70	2.12	19.60	174.07	-1.65	0.01	0.01	.095	14.5	1.822E-06
668.0	174.27	2.33	23.95	174.76	-1.63	0.03	0.01	.070	14.3	1.904E-06
670.6	176.15	2.23	35.42	176.86	-1.62	0.02	0.01	.040	14.0	2.016E-06
673.0	172.78	-1.57	-12.47	172.94	-1.62	0.02	0.00	.112	13.7	2.102E-06
675.2	175.47	-1.29	-16.46	175.65	-1.61	0.02	0.01	.076	13.5	2.190E-06
677.6	176.66	-1.44	-25.51	176.99	-1.61	0.02	0.00	.040	13.2	2.310E-06
680.0	171.91	0.97	6.82	171.97	-1.63	0.01	0.01	.134	12.9	2.433E-06
682.7	173.43	-1.04	-9.10	173.51	-1.64	0.01	0.01	.115	12.7	2.528E-06
685.0	175.62	-1.57	-20.93	175.91	-1.65	0.02	0.00	.060	12.4	2.657E-06
687.5	170.59	2.23	13.58	170.85	-1.65	0.02	0.01	.145	12.1	2.788E-06
689.7	171.10	1.98	12.73	171.31	-1.63	0.02	0.01	.145	11.9	2.959E-06
692.3	171.4[illegible]	1.31	-8.75	171.53	-1.61	0.02	0.01	.145	11.6	3.133E-06
694.5	173.26	1.30	-11.10	173.39	-1.61	0.02	0.00	.111	11.4	3.312E-06
697.0	174.07	1.29	12.55	174.21	-1.63	0.02	0.01	.092	11.1	3.348E-06
699.5	173.83	1.12	10.43	173.94	-1.62	0.02	0.01	.090	10.9	3.686E-06
702.0	174.72	0.47	5.09	174.74	-1.61	0.02	0.00	.084	10.6	3.960E-06
704.3	174.22	0.86	8.34	174.29	-1.61	0.02	0.01	.075	10.3	4.202E-06
706.7	174.19	0.47	4.67	174.21	-1.61	0.02	0.01	.074	10.1	4.452E-06
709.0	174.14	2.02	20.05	174.49	-1.63	0.02	0.00	.073	9.8	4.752E-06
711.5	174.09	-0.41	-3.93	174.10	-1.63	0.02	0.00	.093	9.5	5.063E-06
713.6	174.02	1.08	10.10	174.11	-1.59	0.03	0.01	.087	9.2	5.428E-06
716.2	174.14	0.37	3.61	174.15	-1.61	0.02	0.01	.093	9.0	5.808E-06
718.6	174.97	0.33	3.79	174.94	-1.61	0.02	0.00	.073	8.7	6.280E-06

* -07 INDICATES AN EXPONENT OF 10^{-7}

TABLE VI. - SUMMARY OF AERODYNAMIC DATA FOR

GEMINI V

$T - T_R$, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	Re	Re_{2D}	ρ_∞
990.08	165.4	7.0	25.3	164.0	-1.484	.079	-.052	.219	28.0	.41+04	.31+03	.55592-08*
992.58	166.6	6.1	24.0	165.4	-1.491	.049	-.038	.217	28.5	.49+04	.36+03	.64579-08
994.95	167.5	5.1	22.0	166.6	-1.497	.074	-.028	.183	28.5	.55+04	.42+03	.72032-08
997.33	168.5	4.1	19.5	167.9	-1.503	.072	.018	.164	28.3	.60+04	.44+03	.79305-08
999.70	169.0	3.2	15.9	168.5	-1.505	.073	.073	.132	28.2	.65+04	.48+03	.87427-08
1002.08	168.8	2.9	14.1	168.4	-1.504	.068	.009	.157	28.0	.71+04	.53+03	.95876-08
1004.58	167.9	1.8	8.5	167.7	-1.499	.069	-.032	.165	27.6	.75+04	.58+03	.10612-07
1006.95	167.4	.3	1.5	167.4	-1.497	.081	.016	.166	27.6	.83+04	.64+03	.11523-07
1009.33	166.6	-1.6	-6.6	166.5	-1.492	.074	.043	.179	28.1	.99+04	.74+03	.13333-07
1011.70	166.2	-1.6	-6.3	166.1	-1.489	.083	.017	.189	28.2	.11+05	.83+03	.14959-07
1014.08	166.2	-1.6	-6.4	166.1	-1.489	.090	.045	.177	28.0	.12+05	.90+03	.16363-07
1016.45	166.7	-1.3	-5.6	165.6	-1.492	.056	.071	.175	27.7	.13+05	.98+03	.17776-07
1018.95	167.6	-.2	-.9	167.6	-1.498	.038	.038	.192	27.3	.14+05	.11+04	.19167-07
1021.33	168.3	1.2	6.0	168.3	-1.502	.044	.009	.176	26.8	.14+05	.11+04	.20339-07
1023.70	168.5	2.1	10.0	168.3	-1.502	.048	.004	.174	26.4	.14+05	.12+04	.21654-07
1026.08	168.0	1.6	7.6	167.9	-1.500	.066	.009	.169	26.1	.15+05	.13+04	.23294-07
1028.45	167.3	.2	.7	167.3	-1.496	.085	.029	.144	25.9	.16+05	.14+04	.25128-07
1030.95	167.1	-1.3	-5.8	167.1	-1.495	.078	.041	.158	26.2	.19+05	.15+04	.28203-07
1033.33	167.9	-1.3	-6.2	167.8	-1.499	.063	.035	.167	26.9	.23+05	.18+04	.32709-07
1035.70	169.1	-.8	-4.4	169.0	-1.505	.046	.034	.155	27.1	.26+05	.20+04	.36863-07
1038.08	168.9	-.2	-.8	168.9	-1.504	.050	.018	.149	26.9	.28+05	.22+04	.40035-07
1040.45	168.1	-1.1	-5.0	168.0	-1.500	.054	.037	.161	26.6	.29+05	.24+04	.43115-07
1042.95	167.7	-.6	-2.7	167.7	-1.498	.071	.041	.151	26.3	.31+05	.25+04	.46247-07
1045.33	168.3	.4	2.1	168.3	-1.501	.063	.032	.159	25.9	.32+05	.27+04	.49317-07
1047.70	169.2	.7	3.9	169.2	-1.506	.050	.019	.156	25.8	.34+05	.29+04	.53278-07
1050.08	[illegible]	-.3	-1.5	169.4	-1.506	.052	.029	.147	25.8	.37+05	.32+04	.58237-07
1052.45	169.6	-.5	-2.7	169.6	-1.507	.048	.039	.142	25.7	.40+05	.35+04	.63191-07
1054.95	169.8	.6	3.5	169.8	-1.508	.043	.022	.148	25.4	.43+05	.37+04	.67871-07
1057.33	169.3	.4	2.0	169.3	-1.505	.055	.026	.149	25.2	.45+05	.40+04	.72684-07
1059.70	169.0	-.5	-2.5	169.0	-1.505	.058	.043	.145	25.1	.49+05	.43+04	.78834-07
1062.08	169.9	.2	1.4	169.9	-1.509	.034	.027	.149	25.1	.53+05	.47+04	.86178-07
1064.45	169.4	.6	3.4	169.4	-1.507	.046	.021	.152	25.1	.58+05	.51+04	.93593-07
1066.95	169.1	-.2	-1.0	169.1	-1.505	.053	.042	.147	24.9	.62+05	.55+04	.10108-06
1069.33	169.3	.4	2.3	169.3	-1.509	.050	.030	.150	24.8	.66+05	.59+04	.10874-06
1071.70	169.6	.6	3.1	169.6	-1.513	.041	.026	.150	24.6	.70+05	.64+04	.11577-06
1074.08	169.4	.1	.7	169.4	-1.515	.048	.034	.148	24.5	.75+05	.69+04	.12626-06
1076.45	169.3	.4	2.1	169.3	-1.516	.051	.029	.150	24.5	.81+05	.75+04	.13701-06
1078.95	169.8	.0	.1	169.8	-1.519	.037	.041	.143	24.4	.88+05	.81+04	.14936-06
1081.33	169.7	.5	2.8	169.7	-1.521	.042	.029	.149	24.3	.94+05	.87+04	.16001-06
1083.70	169.6	.5	2.5	169.6	-1.523	.052	.032	.143	24.2	.10+06	.94+04	.17357-06
1086.08	170.5	.2	.9	170.5	-1.528	.033	.037	.136	24.2	.11+06	.10+05	.19801-06
1088.45	169.9	.2	1.7	169.9	-1.527	.050	.032	.139	24.1	.12+06	.11+05	.20337-06
1090.95	170.9	-.1	-.4	170.9	-1.534	.026	.038	.129	23.9	.13+06	.12+05	.21828-06
1093.33	170.6	.2	1.4	170.6	-1.537	.039	.032	.133	23.6	.13+06	.13+05	.23332-06
1095.70	170.5	.3	1.9	170.5	-1.541	.040	.030	.134	23.4	.14+06	.13+05	.24963-06
1098.08	170.7	-.2	-1.0	170.7	-1.547	.036	.043	.127	23.3	.15+06	.14+05	.26795-06
1100.45	170.6	.5	2.9	170.6	-1.550	.038	.029	.135	23.2	.16+06	.16+05	.28893-06
1102.95	170.8	-.0	-.0	170.8	-1.553	.033	.042	.128	23.0	.17+06	.17+05	.31117-06
1105.33	170.7	.3	1.9	170.7	-1.557	.035	.033	.133	22.7	.18+06	.18+05	.33188-06
1107.70	170.9	.2	1.0	170.9	-1.563	.031	.035	.131	22.4	.19+06	.19+05	.35140-06
1110.08	170.9	.2	1.0	170.9	-1.570	.029	.033	.131	22.1	.19+06	.20+05	.37114-06
1112.45	170.7	.1	.5	170.7	-1.576	.037	.039	.129	21.8	.20+06	.21+05	.39258-06
1114.95	171.1	.3	2.0	171.1	-1.585	.030	.036	.128	21.5	.21+06	.22+05	.41876-06
1117.33	170.9	.3	2.0	170.9	-1.590	.039	.035	.125	21.3	.22+06	.24+05	.44806-06
1119.70	171.0	.2	1.4	171.0	-1.594	.037	.038	.125	21.1	.23+06	.25+05	.47897-06
1122.08	171.2	.2	1.9	171.2	-1.600	.029	.037	.126	20.9	.25+06	.27+05	.51166-06
1124.45	171.0	.4	2.5	171.0	-1.606	.037	.032	.129	20.7	.26+06	.29+05	.54657-06
1124.95	171.3	.3	1.9	171.3	-1.612	.027	.034	.125	20.2	.26+06	.30+05	.57218-06
1129.33	171.2	.2	1.3	171.2	-1.620	.033	.033	.126	19.9	.27+06	.32+05	.60226-06
1131.70	171.0	-.1	-.4	171.0	-1.626	.035	.040	.124	19.8	.29+06	.34+05	.65634-06
1134.08	171.3	.5	3.3	171.2	-1.628	.025	.023	.133	19.9	.33+06	.38+05	.72951-06
1136.45	170.9	-.2	-1.0	170.9	-1.624	.035	.044	.125	19.8	.34+06	.41+05	.79556-06
1138.95	170.8	-.1	-.4	170.8	-1.625	.039	.040	.127	19.4	.38+06	.44+05	.84971-06
1141.33	170.7	-.0	-.2	170.7	-1.629	.044	.039	.126	19.1	.39+06	.47+05	.90529-06
1143.70	171.0	-.0	-.1	171.0	-1.636	.040	.038	.124	18.9	.42+06	.50+05	.98266-06
1146.08	171.2	-.1	-.6	171.2	-1.638	.035	.039	.122	18.7	.45+06	.55+05	.10588-05
1148.45	171.4	-.2	-1.0	171.4	-1.641	.034	.039	.119	18.4	.48+06	.58+05	.11476-05
1150.95	171.2	.0	.3	171.2	-1.644	.041	.034	.121	18.0	.50+06	.63+05	.12353-05
1153.33	171.3	-.0	-.0	171.3	-1.649	.039	.036	.120	17.7	.53+06	.67+05	.13278-05
1155.70	171.5	.1	.9	171.5	-1.654	.035	.032	.121	17.3	.55+06	.72+05	.14266-05
1158.08	171.7	-.2	-1.4	171.7	-1.661	.030	.041	.119	16.9	.58+06	.77+05	.15377-05
1160.45	171.7	-.2	-1.2	171.7	-1.666	.033	.047	.113	16.6	.62+06	.83+05	.16686-05

* -08 INDICATES AN EXPONENT OF 10^{-8}

TABLE VI. - SUMMARY OF AERODYNAMIC DATA FOR GEMINI V - Concluded

$T - T_R$, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	Ra	Re_{2D}	ρ_∞
1162.95	171.9	.0	.2	171.9	-1.671	.031	.035	.115	16.3	.66+06	.91+05	.18218-05
1165.33	171.8	.1	.5	171.8	-1.675	.029	.032	.117	15.9	.70+06	.98+05	.19734-05
1167.70	171.7	.2	1.3	171.7	-1.677	.035	.028	.120	15.5	.74+06	.11+06	.21334-05
1170.08	171.8	-.0	-.3	171.8	-1.684	.034	.036	.115	15.1	.77+06	.11+06	.23081-05
1172.45	171.7	.0	.2	171.7	-1.689	.038	.034	.115	14.7	.82+06	.12+06	.25153-05
1174.95	171.6	-.2	-1.5	171.6	-1.685	.041	.045	.110	14.4	.89+06	.14+06	.27834-05
1177.33	171.3	.7	4.3	171.3	-1.679	.052	.011	.129	14.1	.97+06	.15+06	.30904-05
1179.70	171.3	.6	3.6	171.3	-1.674	.061	.033	.117	13.7	.10+07	.17+06	.34150-05
1182.08	171.2	.7	4.6	171.2	-1.670	.062	.031	.113	13.3	.11+07	.19+06	.37524-05
1184.45	171.4	.5	3.6	171.4	-1.668	.056	.036	.111	12.8	.12+07	.20+06	.41110-05
1186.95	171.0	1.5	5.6	170.9	-1.660	.071	.015	.115	12.4	.13+07	.22+06	.45515-05
1189.33	170.9	2.2	13.6	170.6	-1.654	.084	-.016	.113	12.0	.13+07	.24+06	.50123-05
1191.70	171.8	2.2	15.2	171.5	-1.659	.079	.005	.101	11.5	.14+07	.27+06	.54720-05
1194.08	172.0	2.6	17.7	171.6	-1.655	.080	-.002	.098	11.1	.15+07	.29+06	.59710-05
1196.45	172.0	2.3	16.1	171.7	-1.651	.085	.014	.093	10.6	.15+07	.31+06	.64918-05
1198.95	171.5	2.0	13.0	171.2	-1.643	.089	.024	.097	10.1	.16+07	.33+06	.70868-05
1201.33	171.2	1.9	11.9	171.0	-1.637	.073	.016	.112	9.7	.17+07	.35+06	.77162-05
1203.70	171.0	2.1	13.1	170.7	-1.632	.073	.017	.116	9.3	.18+07	.38+06	.83717-05
1206.08	171.2	1.8	11.5	171.0	-1.630	.059	.013	.120	8.8	.18+07	.40+06	.90086-05
1208.45	171.2	1.5	5.9	171.1	-1.629	.061	.031	.114	8.4	.18+07	.42+06	.96724-05
1210.95	171.3	1.7	10.8	171.2	-1.627	.063	.030	.112	8.0	.19+07	.44+06	.10456-04
1213.33	171.7	1.7	11.4	171.6	-1.627	.057	.030	.108	7.6	.19+07	.47+06	.11298-04
1215.70	171.7	1.8	12.4	171.5	-1.625	.062	.028	.107	7.2	.20+07	.50+06	.12204-04
1218.08	171.9	2.0	13.8	171.7	-1.624	.057	.026	.107	6.8	.20+07	.53+06	.13163-04
1220.45	171.8	2.1	14.5	171.6	-1.622	.058	.023	.109	6.4	.21+07	.57+06	.14207-04
1222.95	171.9	2.2	15.5	171.6	-1.621	.061	.029	.105	6.1	.21+07	.63+06	.15398-04
1225.33	172.3	2.4	17.1	172.0	-1.622	.055	.025	.103	5.7	.22+07	.68+06	.16644-04
1227.70	172.3	2.7	19.4	171.8	-1.620	.066	.016	.101	5.4	.22+07	.74+06	.18108-04
1230.08	173.3	4.1	31.4	172.2	-1.624	.074	-.007	.092	5.1	.23+07	.80+06	.19717-04
1232.45	175.3	4.1	40.9	173.8	-1.632	.085	.007	.056	4.8	.23+07	.88+06	.21469-04
1234.83	176.2	4.7	51.2	174.9	-1.634	.079	-.027	.053	4.5	.24+07	.96+06	.23425-04
1237.33	177.7	4.1	61.3	175.3	-1.631	.071	-.026	.036	4.2	.25+07	.11+07	.25565-04
1239.70	178.6	3.6	68.7	176.1	-1.626	.067	-.026	.024	4.0	.25+07	.12+07	.27822-04
1242.08	180.0	3.2	85.7	176.8	-1.620	.051	-.027	.020	3.7	.26+07	.13+07	.30469-04
1244.45	-179.5	3.2	95.6	176.8	-1.287	.043	-.031	.015	3.9	.40+07	.18+07	.41913-04
1246.83	-178.5	2.9	117.2	176.7	-1.282	.035	-.026	.024	3.6	.40+07	.20+07	.46041-04
1249.33	-178.0	3.2	12[illegible].7	176.2	-1.292	.039	-.027	.030	3.3	.40+07	.22+07	.49958-04
1251.70	-177.4	3.2	125.3	175.9	-1.302	.036	-.024	.039	3.0	.39+07	.24+07	.53676-04
1254.08	-176.9	3.3	132.8	175.5	-1.311	.033	-.024	.048	2.8	.39+07	.27+07	.57826-04
1256.45	-177.3	3.7	126.0	175.5	-1.320	.045	-.028	.039	2.6	.38+07	.30+07	.62321-04
1258.83	-177.2	4.3	122.5	174.9	-1.329	.046	-.034	.046	2.4	.38+07	.34+07	.67105-04
1261.33	-177.2	4.6	121.7	174.6	-1.336	.049	-.031	.050	2.2	.38+07	.38+07	.72913-04
1263.70	-176.4	4.4	129.1	174.3	-1.344	.039	-.021	.066	2.1	.38+07	.43+07	.79269-04
1266.08	-176.1	4.6	130.9	174.0	-1.350	.038	-.021	.073	1.9	.38+07	.49+07	.86122-04
1268.45	-175.6	4.6	133.9	173.6	-1.356	.036	-.022	.081	1.8	.39+07	.57+07	.93829-04
1270.83	-174.8	4.4	135.8	173.2	-1.364	.033	-.019	.090	1.7	.40+07	.65+07	.10241-03
1273.33	-173.9	4.1	146.1	172.7	-1.375	.028	-.015	.104	1.6	.40+07	.76+07	.11136-03
1275.70	-173.8	4.4	144.7	172.5	-1.387	.039	-.023	.099	1.4	.40+07	.86+07	.11938-03

TABLE VII. - SUMMARY OF AERODYNAMIC DATA FOR GEMINI VIII

$T - T_R$, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	Re	Re_{2D}	ρ_∞
1499.09	164.5	-1.2	-4.4	164.5	-1.478	.167	-.091	.143	32.6	.69+04	.39+03	.70662-08*
1501.96	164.8	-.3	-1.0	164.8	-1.480	.138	.013	.173	30.7	.61+04	.39+03	.70532-08
1503.89	165.4	.5	2.0	165.4	-1.484	.080	.044	.196	29.6	.59+04	.39+03	.70985-08
1506.76	166.6	1.6	6.7	166.5	-1.492	-.014	.025	.220	29.2	.61+04	.42+03	.76483-08
1511.91	168.0	1.8	8.5	167.8	-1.500	.118	.006	.134	28.1	.64+04	.47+03	.85444-08
1514.07	168.0	1.4	6.5	167.9	-1.500	.114	.018	.136	28.2	.69+04	.51+03	.92642-08
1516.20	167.5	.8	3.5	167.5	-1.497	.093	-.011	.157	27.8	.71+04	.54+03	.96788-08
1519.37	166.6	.2	.6	166.5	-1.492	.054	-.006	.200	27.1	.69+04	.55+03	.98576-08
1520.53	165.6	-.3	-1.3	165.6	-1.485	.033	.034	.223	27.5	.78+04	.60+03	.10872-07
1523.72	164.4	-.6	-2.1	164.4	-1.477	.058	-.004	.238	28.1	.94+04	.70+03	.12672-07
1525.88	164.3	-.3	-1.1	164.3	-1.477	.071	-.044	.220	28.0	.10+05	.75+03	.13521-07
1528.00	165.1	.1	.5	165.1	-1.482	.064	-.056	.205	27.9	.10+05	.77+03	.13991-07
1530.19	166.4	.6	2.5	166.4	-1.490	.041	-.026	.208	27.5	.11+05	.83+03	.14964-07
1533.39	168.3	1.1	5.2	168.3	-1.502	.058	-.007	.167	28.4	.14+05	.99+03	.17861-07
1535.51	168.6	1.0	4.9	168.6	-1.503	.043	-.006	.172	28.6	.15+05	.11+04	.19507-07
1537.69	168.0	.6	3.0	168.0	-1.500	.003	-.009	.207	28.7	.16+05	.12+04	.21279-07
1539.82	166.9	.2	1.0	166.9	-1.493	.018	-.011	.218	29.0	.18+05	.13+04	.23327-07
1543.03	165.8	-.1	-.3	165.8	-1.486	.062	.006	.229	28.7	.20+05	.14+04	.25752-07
1545.20	164.4	.2	.9	164.4	-1.490	.040	-.010	.213	28.9	.22+05	.15+04	.28068-07
1547.32	167.6	.7	3.2	167.6	-1.498	.025	-.023	.196	28.8	.23+05	.17+04	.30106-07
1552.71	168.5	.9	4.3	168.4	-1.502	.037	-.016	.177	27.9	.25+05	.19+04	.34037-07
1554.87	167.2	.6	2.7	167.2	-1.495	.057	.004	.187	27.8	.26+05	.20+04	.36232-07
1557.00	166.5	.8	3.4	166.5	-1.491	.056	.014	.200	27.4	.27+05	.21+04	.37624-07
1559.17	167.0	1.2	5.2	167.0	-1.494	.057	-.000	.191	26.9	.27+05	.21+04	.38779-07
1561.33	168.3	1.5	7.3	168.2	-1.501	.052	-.013	.172	26.8	.28+05	.22+04	.41046-07
1564.52	168.9	.3	1.6	168.9	-1.504	.024	.011	.179	26.6	.30+05	.24+04	.44395-07
1566.68	167.5	-1.4	-6.3	167.4	-1.497	.040	.030	.189	26.4	.31+05	.26+04	.46615-07
1568.80	166.5	-.6	-2.6	166.5	-1.491	.053	.007	.203	26.2	.32+05	.27+04	.48775-07
1570.99	167.2	1.4	5.9	167.1	-1.495	.054	-.021	.189	26.0	.34+05	.28+04	.51265-07
1574.19	169.4	1.3	7.2	169.3	-1.507	.020	-.014	.171	25.9	.36+05	.30+04	.55364-07
1576.31	168.5	-.8	-4.1	168.5	-1.503	.037	.015	.176	25.7	.37+05	.32+04	.58099-07
1578.45	167.1	-1.2	-5.3	167.0	-1.494	.060	.005	.189	25.6	.39+05	.33+04	.60850-07
1580.59	167.1	.6	2.5	167.1	-1.495	.056	-.009	.189	25.5	.40+05	.35+04	.63591-07
1583.79	169.3	1.6	8.5	169.2	-1.506	.022	-.022	.149	25.5	.44+05	.38+04	.69927-07
1585.91	168.0	-.7	-3.5	168.0	-1.504	.038	.011	.172	25.6	.47+05	.41+04	.74354-07
1588.05	167.1	-.5	-2.0	167.1	-1.494	.058	.006	.189	25.4	.49+05	.42+04	.77647-07
1590.19	167.0	.8	3.3	167.0	-1.494	.054	-.005	.193	25.3	.51+05	.44+04	.81206-07
1593.35	169.7	-.1	-.3	169.7	-1.508	.019	-.000	.168	25.0	.53+05	.47+04	.86332-07
1595.51	168.7	.0	.1	168.7	-1.504	.038	-.004	.173	24.9	.55+05	.49+04	.90326-07
1597.65	167.4	1.6	7.0	167.3	-1.498	.052	-.017	.187	24.9	.58+05	.52+04	.94578-07
1599.79	168.0	1.4	6.4	167.9	-1.503	.048	-.009	.180	24.7	.59+05	.53+04	.98158-07
1602.99	169.1	-.6	-3.3	169.1	-1.513	.023	.019	.172	24.5	.62+05	.57+04	.10466-06
1605.11	167.7	1.3	6.1	167.6	-1.509	.045	-.014	.186	24.3	.64+05	.59+04	.10866-06
1607.25	168.0	1.0	4.6	167.9	-1.513	.044	-.013	.183	24.2	.66+05	.61+04	.11276-06
1609.39	168.9	-.2	-1.2	168.9	-1.522	.033	.001	.173	24.1	.69+05	.64+04	.11785-06
1612.59	167.9	2.5	11.5	167.5	-1.517	.050	-.043	.174	24.0	.72+05	.68+04	.12524-06
1614.68	168.7	.3	1.5	168.7	-1.525	.038	-.001	.174	23.8	.74+05	.71+04	.13015-06
1616.80	169.4	-.7	-3.9	169.4	-1.532	.028	.016	.165	23.6	.76+05	.73+04	.13423-06
1618.96	168.3	.8	3.9	168.3	-1.529	.038	-.008	.189	23.4	.76+05	.74+04	.13719-06
1622.15	169.1	-1.5	-7.6	169.0	-1.540	.026	.037	.153	23.3	.80+05	.79+04	.14603-06
1624.24	169.4	1.1	5.8	169.3	-1.543	.031	-.013	.166	23.1	.82+05	.81+04	.15063-06
1626.40	167.5	1.3	6.0	167.5	-1.535	.058	-.016	.182	22.9	.83+05	.84+04	.15485-06
1628.53	168.1	.1	.4	168.1	-1.543	.043	.002	.182	22.9	.88+05	.88+04	.16217-06
1631.72	169.3	2.3	11.7	169.0	-1.550	.020	-.055	.155	23.1	.96+05	.95+04	.17555-06
1633.84	168.0	.0	.2	168.0	-1.539	.044	.005	.183	23.3	.10+06	.10+05	.18582-06
1635.97	169.3	1.6	8.4	169.2	-1.543	.017	-.027	.159	23.3	.11+06	.11+05	.19433-06
1639.11	167.6	-.8	-3.7	167.5	-1.531	.062	.033	.175	23.3	.12+06	.11+05	.21119-06
1641.27	169.0	1.5	7.8	168.9	-1.539	.034	-.023	.159	23.4	.12+06	.12+05	.22202-06
1643.40	169.2	.6	3.1	169.2	-1.540	.028	-.001	.172	23.5	.13+06	.13+05	.23407-06
1645.53	168.0	.5	2.5	168.0	-1.531	.055	-.009	.175	23.4	.14+06	.13+05	.24344-06
1648.71	170.1	.5	2.9	170.1	-1.545	.003	-.000	.172	23.0	.14+06	.14+05	.25344-06
1650.87	168.2	1.1	5.3	168.1	-1.540	.052	-.011	.175	23.1	.15+06	.14+05	.26554-06
1652.97	169.6	1.1	6.2	169.5	-1.549	.025	-.009	.147	22.9	.15+06	.15+05	.27286-06
1655.19	168.9	.5	2.7	168.9	-1.549	.044	.003	.165	22.6	.15+06	.15+05	.27963-06
1659.31	169.7	.8	4.6	169.7	-1.560	.026	-.005	.165	22.5	.16+06	.16+05	.29349-06
1660.43	168.8	1.5	7.6	168.7	-1.557	.046	-.015	.158	22.3	.16+06	.16+05	.30258-06
1662.57	169.0	.4	1.9	169.0	-1.561	.030	.025	.169	22.0	.16+06	.16+05	.30767-06
1667.87	168.8	-.9	-4.6	168.8	-1.566	.051	.025	.141	21.8	.17+06	.18+05	.33598-06
1670.00	169.1	2.1	10.7	169.0	-1.572	.036	-.049	.154	21.7	.18+06	.18+05	.34465-06
1672.12	169.1	-1.4	-7.5	169.0	-1.575	.027	.093	.155	21.6	.18+06	.19+05	.35634-06
1677.47	169.7	.3	1.9	169.7	-1.582	.026	.012	.144	21.5	.19+06	.20+05	.38660-06
1679.60	168.5	.2	1.2	168.5	-1.580	.051	.012	.148	21.2	.20+06	.21+05	.39862-06
1681.72	169.4	.6	3.0	169.4	-1.589	.028	-.003	.145	20.9	.20+06	.21+05	.40621-06
1683.86	168.8	.6	2.8	168.8	-1.589	.050	-.000	.145	20.7	.20+06	.22+05	.41396-06

* - 08 INDICATES AN EXPONENT OF 10^{-8}

TABLE VII. - SUMMARY OF AERODYNAMIC DATA FOR GEMINI VIII - Concluded

T - T_R, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	Re	Re_{2D}	ρ_∞
1687.07	169.8	2.0	11.1	169.6	-1.602	.016	-.056	.144	20.4	.20+06	.22+05	.42818-06
1689.20	168.3	.1	.2	168.3	-1.596	.062	.021	.164	20.4	.21+06	.23+05	.44550-06
1691.32	169.8	.7	3.9	169.7	-1.608	.025	.009	.165	20.3	.22+06	.24+05	.46101-06
1693.39	169.9	.3	1.5	169.9	-1.611	.020	.016	.142	20.2	.22+06	.25+05	.47629-06
1696.31	169.5	1.5	8.0	169.4	-1.610	.042	-.021	.157	19.8	.22+06	.25+05	.48799-06
1701.33	168.5	.4	2.0	168.5	-1.607	.061	.039	.157	19.9	.25+06	.29+05	.55347-06
1703.22	169.9	1.8	5.9	169.9	-1.619	.019	-.018	.163	19.7	.26+06	.29+05	.56797-06
1706.28	169.1	1.8	9.2	169.0	-1.614	.065	-.024	.151	19.2	.25+06	.30+05	.59123-06
1708.45	169.2	1.4	7.3	169.1	-1.618	.063	-.002	.153	19.2	.28+06	.32+05	.62576-06
1710.58	170.2	.8	4.7	170.1	-1.627	.040	.021	.146	19.0	.29+06	.34+05	.65594-06
1712.74	170.0	1.4	7.7	169.9	-1.627	.052	-.007	.145	18.9	.30+06	.36+05	.69552-06
1714.90	170.4	1.8	10.7	170.2	-1.631	.041	-.026	.142	18.8	.32+06	.38+05	.74282-06
1718.09	169.5	.6	3.0	169.5	-1.624	.076	.005	.138	18.7	.35+06	.42+05	.81974-06
1720.25	169.6	1.0	5.5	169.5	-1.626	.065	-.005	.144	18.6	.37+06	.44+05	.87316-06
1722.38	170.1	.5	3.0	170.1	-1.633	.041	.017	.146	18.3	.39+06	.47+05	.91989-06
1724.53	169.9	.4	2.1	169.9	-1.633	.041	.019	.150	18.1	.40+06	.49+05	.96665-06
1727.73	169.4	.1	.9	169.4	-1.630	.053	.016	.153	17.9	.43+06	.53+05	.10516-05
1729.85	170.2	.5	2.9	170.2	-1.641	.028	.002	.154	17.6	.45+06	.56+05	.11053-05
1731.98	170.2	.9	5.3	170.1	-1.643	.033	-.015	.152	17.3	.46+06	.58+05	.11559-05
1734.13	170.0	1.1	6.4	170.0	-1.644	.038	-.021	.149	17.0	.47+06	.60+05	.12056-05
1737.33	170.3	.4	2.5	170.3	-1.650	.034	.003	.150	16.7	.49+06	.65+05	.12944-05
1739.45	170.1	.4	2.1	170.1	-1.651	.047	.008	.146	16.5	.51+06	.68+05	.13637-05
1741.58	169.8	.6	3.1	169.8	-1.650	.053	.002	.147	16.3	.53+06	.71+05	.14307-05
1743.73	170.0	.7	3.8	170.0	-1.654	.046	-.001	.148	16.0	.55+06	.75+05	.14960-05
1746.89	170.9	.7	4.5	170.9	-1.667	.025	-.000	.145	15.8	.59+06	.81+05	.16309-05
1748.94	170.6	.9	5.5	170.6	-1.665	.035	-.008	.144	15.6	.61+06	.85+05	.17045-05
1750.93	170.7	1.2	7.4	170.7	-1.669	.034	-.019	.142	15.2	.60+06	.86+05	.17341-05
1753.89	171.0	1.3	8.3	170.9	-1.676	.033	-.016	.139	14.7	.60+06	.89+05	.17986-05
1758.97	170.6	.6	3.5	170.6	-1.672	.046	.000	.138	14.4	.67+06	.10+06	.20605-05
1760.82	170.6	.6	3.4	170.6	-1.669	.052	-.001	.134	14.1	.68+06	.11+06	.21349-05
1763.85	170.9	1.7	10.4	170.8	-1.671	.049	-.025	.128	13.8	.70+06	.11+06	.22590-05
1765.74	171.1	1.7	10.6	171.0	-1.669	.040	-.025	.130	13.6	.73+06	.12+06	.23641-05
1767.73	171.5	1.1	7.1	171.4	-1.672	.038	-.005	.128	13.2	.72+06	.12+06	.24144-05
1770.69	170.8	.3	1.9	170.8	-1.661	.079	.014	.112	12.8	.74+06	.13+06	.25763-05
1775.73	171.5	1.1	7.5	171.4	-1.669	.067	-.017	.108	12.4	.87+06	.15+06	.31098-05
1777.62	171.9	.9	6.5	171.9	-1.665	.046	-.009	.114	12.2	.91+06	.16+06	.32973-05
1780.64	171.6	.9	6.7	171.5	-1.659	.053	-.011	.116	11.6	.93+06	.17+06	.35549-05
1782.65	171.7	.7	4.7	171.7	-1.654	.041	.003	.121	11.4	.99+06	.19+06	.38600-05
1784.78	171.5	.2	1.3	171.5	-1.651	.043	.020	.120	11.1	.10+07	.20+06	.41526-05
1786.97	171.3	.2	1.4	171.3	-1.647	.044	.017	.124	10.8	.11+07	.22+06	.44874-05
1790.13	171.5	.6	4.0	171.5	-1.645	.028	.009	.132	10.5	.12+07	.24+06	.51484-05
1792.25	171.2	-.3	-1.9	171.1	-1.640	.034	.018	.132	10.3	.13+07	.26+06	.56026-05
1794.38	171.3	.6	4.2	171.3	-1.638	.035	-.016	.130	9.9	.13+07	.28+06	.59624-05
1796.56	170.8	.7	4.5	170.8	-1.632	.049	-.013	.130	9.6	.14+07	.29+06	.63747-05
1799.73	171.0	-.6	-3.9	171.0	-1.631	.050	.028	.123	9.2	.15+07	.32+06	.71914-05
1801.85	171.1	1.3	8.2	171.0	-1.629	.050	-.027	.122	8.9	.16+07	.34+06	.77897-05
1803.98	171.4	.8	5.1	171.4	-1.629	.049	-.008	.121	8.6	.16+07	.36+06	.83197-05
1806.13	171.6	.6	3.8	171.6	-1.629	.050	-.001	.117	8.2	.17+07	.38+06	.88953-05
1809.17	171.9	1.1	7.6	171.8	-1.629	.050	-.017	.110	7.8	.18+07	.41+06	.98360-05
1811.14	172.2	1.2	8.6	172.2	-1.628	.056	-.017	.102	7.5	.18+07	.43+06	.10301-04
1814.17	173.4	.8	6.7	173.4	-1.631	.042	-.001	.090	7.1	.19+07	.47+06	.11474-04
1816.10	173.4	.6	5.2	173.4	-1.629	.042	-.000	.090	6.9	.20+07	.50+06	.12363-04
1819.08	172.9	.3	2.3	172.9	-1.627	.063	.008	.085	6.5	.21+07	.56+06	.13762-04
1821.02	172.7	.2	1.3	172.7	-1.625	.067	.004	.085	6.3	.22+07	.61+06	.14879-04
1822.99	173.4	1.0	8.4	173.3	-1.627	.051	-.013	.096	6.0	.22+07	.66+06	.15850-04
1825.97	174.2	1.2	11.6	174.0	-1.629	.031	-.023	.081	5.6	.24+07	.74+06	.18116-04
1827.94	174.2	1.3	12.7	174.1	-1.628	.024	-.020	.086	5.4	.25+07	.81+06	.19778-04
1829.97	173.7	.3	2.5	173.7	-1.626	.048	.014	.089	4.9	.26+07	.91+06	.22261-04
1832.98	174.8	.6	6.2	174.8	-1.629	.024	.010	.075	4.7	.27+07	.10+07	.24600-04
1835.10	174.6	.2	2.0	174.6	-1.625	.035	.018	.069	4.5	.28+07	.11+07	.26775-04
1838.28	173.4	.8	4.5	173.1	-1.615	.068	-.006	.074	4.1	.29+07	.13+07	.30707-04
1840.45	174.9	.7	7.7	174.8	-1.614	.026	.002	.075	3.9	.32+07	.15+07	.34410-04
1842.54	175.4	.9	11.6	175.4	-1.612	.011	-.001	.075	3.7	.33+07	.14+07	.37953-04
1844.71	175.2	.5	5.6	175.2	-1.607	.014	.008	.073	3.4	.33+07	.18+07	.41086-04
1847.08	174.3	.4	4.4	174.3	-1.598	.041	-.001	.074	3.1	.36+07	.22+07	.48129-04
1849.97	175.6	1.0	12.5	175.5	-1.597	.005	-.018	.067	2.9	.39+07	.25+07	.53556-04
1852.10	175.6	-.2	-2.1	175.6	-1.595	.009	.011	.069	2.7	.38+07	.28+07	.58603-04
1854.24	174.9	-.2	-2.2	174.9	-1.596	.022	.009	.073	2.5	.39+07	.32+07	.63778-04
1857.40	175.3	.4	5.5	175.3	-1.600	-.009	-.008	.075	2.3	.39+07	.38+07	.72390-04
1859.53	174.9	-.0	-.5	174.9	-1.603	-.014	.010	.079	2.1	.40+07	.44+07	.79648-04
1861.66	173.2	.4	2.9	173.2	-1.597	.018	.009	.108	2.0	.41+07	.51+07	.87617-04
1863.79	172.7	.9	7.0	172.6	-1.593	.021	-.008	.115	1.9	.43+07	.59+07	.98827-04
1866.99	171.3	1.7	10.7	171.1	-1.588	.050	-.026	.129	1.7	.44+07	.76+07	.11018-03

TABLE VIII. - SUMMARY OF AERODYNAMIC DATA FOR

GEMINI X

$T - T_R$, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	R_e	Re_{2D}	ρ_∞
1471.15	167.9	-7.0	-30.0	166.2	-1.590	-.001	.047	.214	33.6	.37+04	.47+03	.84286-08*
1474.21	164.8	-4.4	-15.7	164.3	-1.480	.006	.065	.235	30.[illegible]	.68+04	.44+03	.79946-08
1476.42	163.0	-1.1	-3.5	163.0	-1.468	.116	.060	.211	31.4	.88+04	.54+03	.96545-08
1478.58	161.8	2.7	8.1	161.6	-1.457	.161	.012	.214	31.2	.96+04	.59+03	.10591-07
1480.71	161.6	6.0	17.6	160.8	-1.456	.100	-.058	.262	30.9	.10+05	.65+03	.11677-07
1482.89	162.9	7.9	24.5	161.4	-1.457	.037	.001	.309	30.3	.11+05	.70+03	.12539-07
1486.09	166.4	5.3	21.0	165.5	-1.490	.055	-.100	.179	30.9	.14+05	.86+03	.15475-07
1488.26	168.8	3.0	14.9	168.4	-1.504	.042	.007	.176	30.1	.14+05	.90+03	.16254-07
1490.42	169.7	1.1	6.1	169.6	-1.508	.066	-.038	.131	29.5	.14+05	.95+03	.17215-07
1492.56	168.7	.4	1.9	168.7	-1.504	.024	-.007	.182	29.3	.15+05	.10+04	.18755-07
1495.77	165.2	-.7	-2.5	165.2	-1.483	.016	.031	.239	28.8	.16+05	.12+04	.20963-07
1497.93	163.3	-1.4	-4.6	163.3	-1.470	.045	-.011	.267	28.7	.18+05	.13+04	.22856-07
1500.10	163.1	-1.1	-3.6	163.1	-1.469	.121	.032	.213	27.6	.17+05	.13+04	.2345[illegible]-07
1502.27	165.0	1.8	6.7	164.9	-1.481	.096	.005	.202	27.8	.19+05	.14+04	.25590-07
1504.43	167.6	4.2	18.3	167.0	-1.498	.079	-.029	.173	27.6	.20+05	.13+04	.27526-07
1507.62	169.6	2.9	15.4	169.2	-1.507	.018	-.045	.157	27.2	.21+05	.17+04	.30163-07
1509.78	167.7	-.1	-.4	167.7	-1.498	.017	-.039	.190	27.5	.24+05	.18+04	.33535-07
1511.95	164.5	-1.6	-5.9	164.4	-1.479	.071	.006	.227	27.4	.26+05	.20+04	.36208-07
1514.09	163.3	-.6	-1.9	163.3	-1.479	.093	.020	.231	27.3	.29+05	.21+04	.39043-07
1517.29	167.5	2.4	10.5	167.2	-1.497	.078	-.019	.171	27.0	.30+05	.24+04	.43353-07
1519.46	170.3	1.6	5.3	170.1	-1.510	.029	-.022	.149	26.7	.31+05	.25+04	.45952-07
1521.62	169.3	.1	.7	169.3	-1.506	.009	-.019	.174	26.3	.32+05	.26+04	.47939-07
1523.76	165.7	.1	.3	165.7	-1.486	.029	.009	.234	26.2	.34+05	.28+04	.51518-07
1526.97	164.9	2.4	8.7	164.7	-1.483	.089	-.028	.207	25.9	.36+05	.31+04	.56220-07
1529.13	168.8	1.3	6.3	168.7	-1.504	.066	-.015	.153	25.9	.39+05	.33+04	.60632-07
1531.27	170.7	.2	1.0	170.7	-1.512	.015	.006	.154	26.0	.43+05	.36+04	.65559-07
1533.43	167.9	2.0	5.3	167.8	-1.500	.008	.008	.209	25.8	.45+05	.39+04	.69387-07
1536.61	165.0	2.5	5.4	164.9	-1.481	.092	-.042	.199	25.6	.48+05	.42+04	.76002-07
1538.77	168.7	-.3	-1.6	168.7	-1.504	.063	.001	.156	25.6	.52+05	.45+04	.81796-07
1540.90	170.5	.4	2.4	170.5	-1.512	.009	.026	.149	25.6	.56+05	.48+04	.87532-07
1543.03	167.6	3.1	13.9	167.2	-1.498	.008	-.042	.187	25.4	.58+05	.51+04	.92404-07
1546.19	166.2	-1.1	-4.3	166.2	-1.489	.100	.013	.176	25.3	.63+05	.55+04	.10096-06
1548.35	169.9	.3	1.9	169.9	-1.509	.047	.015	.145	25.0	.64+05	.58+04	.10546-06
1550.48	169.3	2.6	13.4	169.0	-1.507	.003	-.026	.177	24.7	.64+05	.60+04	.11019-06
1552.61	165.9	.4	1.7	165.9	-1.492	.059	-.010	.229	24.6	.65+05	.63+04	.11621-06
1555.79	167.8	1.7	7.8	167.7	-1.507	.049	.033	.145	24.[illegible]	.71+05	.67+04	.12236-06
1557.95	169.8	2.9	15.8	169.4	-1.527	.019	-.015	.171	24.0	.74+05	.70+04	.12836-06
1560.08	167.5	.1	.6	167.5	-1.517	.026	-.013	.202	23.7	.75+05	.72+04	.13302-06
1562.24	166.7	.4	1.6	166.7	-1.517	.077	.076	.181	23.5	.77+05	.75+04	.13832-06
1564.40	169.5	1.6	9.0	168.4	-1.534	.047	-.020	.170	23.4	.80+05	.79+04	.14518-06
1567.59	166.9	-1.1	-4.7	166.9	-1.525	.041	.042	.197	23.3	.87+05	.85+04	.15764-06
1569.72	167.7	2.4	10.7	167.4	-1.531	.064	-.018	.174	23.4	.93+05	.91+04	.16742-06
1571.85	169.5	.0	.2	169.5	-1.540	.022	-.013	.149	23.4	.98+05	.96+04	.17692-06
1574.00	168.4	.6	3.1	168.4	-1.534	.021	.022	.185	23.8	.11+06	.10+05	.19340-06
1577.19	169.2	-.0	-.1	169.2	-1.531	.039	-.007	.144	24.1	.13+06	.12+05	.21597-06
1579.32	168.4	1.4	6.9	168.3	-1.521	.019	.013	.190	23.8	.13+06	.12+05	.22391-06
1581.45	167.4	1.4	6.4	167.3	-1.519	.064	-.033	.175	23.9	.14+06	.13+05	.23707-06
1583.60	168.4	1.4	6.7	168.4	-1.524	.042	-.016	.176	23.8	.14+06	.14+05	.25038-06
1586.79	166.4	.7	2.8	166.6	-1.514	.080	-.009	.183	23.8	.14+06	.15+05	.27138-06
1588.92	169.3	1.4	7.1	169.2	-1.532	.028	-.019	.171	23.5	.15+06	.15+05	.27923-06
1591.08	167.8	.6	2.8	167.8	-1.530	.029	.001	.196	23.2	.16+06	.15+05	.28615-06
1593.23	167.8	1.1	5.1	167.7	-1.535	.056	-.004	.179	23.0	.16+06	.16+05	.29708-06
1596.39	167.6	-.4	-1.8	167.6	-1.538	.031	.040	.189	22.6	.16+06	.16+05	.30741-06
1598.58	168.2	2.0	5.6	169.1	-1.551	.058	-.037	.145	22.4	.17+06	.17+05	.31762-06
1600.68	168.6	-.3	-1.7	168.6	-1.557	.012	.020	.187	22.1	.17+06	.17+05	.32613-06
1602.83	168.4	.0	.1	168.4	-1.561	.045	.018	.174	22.0	.17+06	.18+05	.33444-06
1605.03	168.7	.2	.9	168.7	-1.566	.006	.040	.172	21.6	.17+06	.18+05	.34730-06
1608.19	168.0	.1	.7	168.0	-1.568	.059	-.016	.173	21.7	.18+06	.19+05	.36693-06
1610.28	169.0	1.2	6.0	169.0	-1.575	.017	-.001	.183	21.5	.19+06	.20+05	.37799-06
1612.43	169.0	.7	3.4	169.0	-1.577	.030	.005	.176	21.6	.20+06	.21+05	.38659-06
1615.59	168.7	1.6	7.9	168.6	-1.576	.012	-.034	.177	21.3	.20+06	.22+05	.40885-06
1617.75	168.7	1.1	5.6	168.6	-1.589	.040	.001	.149	21.3	.21+06	.22+05	.42817-06
1619.88	168.4	.8	3.8	168.3	-1.578	.026	-.009	.198	21.1	.21+06	.23+05	.43936-06
1622.05	168.9	1.4	7.0	168.8	-1.586	.036	-.017	.173	21.0	.22+06	.23+05	.44404-06
1625.23	167.6	.4	1.7	167.5	-1.578	.060	.027	.180	20.8	.22+06	.24+05	.46490-06
1627.39	169.2	.7	3.5	169.2	-1.596	.031	-.001	.177	20.5	.22+06	.25+05	.47771-06
1629.48	168.0	1.9	7.0	167.9	-1.590	.051	-.010	.181	20.4	.23+06	.25+05	.48525-06
1631.63	168.4	1.3	6.3	168.4	-1.587	.041	-.016	.177	20.3	.25+06	.26+05	.49677-06
1634.83	167.4	1.1	4.9	167.4	-1.591	.086	-.010	.167	20.2	.25+06	.27+05	.52376-06
1636.98	168.4	1.9	9.1	168.3	-1.600	.032	-.025	.181	20.0	.25+06	.28+05	.53988-06
1639.08	168.4	.4	2.1	168.4	-1.604	.094	.011	.170	19.9	.25+06	.28+05	.54478-06
1641.23	167.7	-.0	-.1	167.7	-1.599	.083	[illegible]	.170	19.8	.26+06	.29+05	.55096-06
1644.27	169.3	1.7	9.1	169.2	-1.614	.026	[illegible]	.199	19.9	.29+06	.29+05	.56863-06

* -08 INDICATES AN EXPONENT OF 10^{-8}

TABLE VIII. - SUMMARY OF AERODYNAMIC DATA FOR

GEMINI X - Concluded

$T - T_R$, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	R_e	Re_{2D}	ρ_∞
1646.24	167.6	-.2	-1.1	167.6	-1.601	.091	-.039	.156	19.4	.26+06	.30+05	.58650-06
1649.30	170.4	.3	1.6	170.4	-1.626	-.024	-.052	.133	19.0	.26+06	.30+05	.59070-06
1651.20	168.0	.7	3.3	168.0	-1.608	.095	-.041	.146	19.1	.27+06	.31+05	.61261-06
1653.20	167.4	1.8	8.2	167.3	-1.601	.088	-.086	.143	18.9	.27+06	.32+05	.62413-06
1656.15	169.0	.4	1.9	169.0	-1.619	.075	-.034	.143	18.7	.28+06	.33+05	.64668-06
1659.14	168.6	-.0	-.0	168.6	-1.617	.087	-.092	.121	18.6	.28+06	.34+05	.66609-06
1663.39	167.9	.5	2.2	167.9	-1.609	.097	-.058	.143	18.1	.29+06	.36+05	.71476-06
1665.56	169.2	1.7	8.[illegible]	169.1	-1.628	.021	-.063	.152	17.8	.30+06	.37+05	.73243-06
1667.74	168.1	-.6	-2.6	169.1	-1.618	.072	-.017	.163	17.9	.32+06	.40+05	.78424-06
1670.95	167.3	.2	.9	167.3	-1.607	.076	-.023	.174	17.6	.34+06	.42+05	.83776-06
1673.07	170.6	1.1	6.4	170.6	-1.647	.004	-.034	.145	17.2	.33+06	.43+05	.86778-06
1675.24	168.7	.9	4.7	168.7	-1.639	.065	-.072	.139	17.1	.35+06	.45+05	.89615-06
1680.59	170.7	1.8	11.1	170.5	-1.653	.009	-.080	.117	16.6	.37+06	.50+05	.99688-06
1682.87	168.0	.6	3.0	168.0	-1.625	.097	-.026	.149	16.7	.41+06	.55+05	.10894-05
1685.03	168.4	-.2	-1.1	168.4	-1.629	.075	.023	.159	16.5	.43+06	.57+05	.11371-05
1687.20	170.5	.6	3.4	170.5	-1.657	.016	.010	.156	16.4	.45+06	.61+05	.12129-05
1689.34	169.7	1.4	7.8	169.6	-1.648	.040	-.070	.156	16.4	.49+06	.65+05	.12963-05
1692.50	168.9	1.3	6.4	168.8	-1.639	.068	-.010	.155	16.0	.51+06	.69+05	.13806-05
1694.53	169.3	.8	4.2	169.2	-1.647	.055	-.016	.154	15.7	.51+06	.71+05	.14301-05
1696.80	170.5	1.3	7.9	170.4	-1.669	.033	-.080	.116	15.5	.57+06	.74+05	.14812-05
1702.10	168.6	-.0	-.1	168.6	-1.642	.100	-.016	.138	14.9	.55+06	.82+05	.14654-05
1704.15	170.5	.8	4.3	170.5	-1.672	.051	-.082	.139	14.5	.55+06	.83+05	.16777-05
1709.23	170.6	.3	1.8	170.6	-1.669	.047	-.035	.130	13.9	.59+06	.96+05	.18447-05
1711.12	169.0	.3	1.6	169.0	-1.645	.090	-.054	.124	13.8	.61+06	.10+06	.19839-05
1714.15	168.8	1.2	6.1	168.7	-1.641	.101	-.089	.127	13.5	.66+06	.11+06	.21830-05
1716.12	170.9	1.2	7.3	170.8	-1.665	.022	-.072	.119	13.2	.67+06	.11+06	.22867-05
1718.21	170.9	.6	3.9	170.9	-1.662	.037	-.075	.110	13.0	.72+06	.12+06	.24723-05
1721.30	171.0	.3	1.8	171.0	-1.662	.028	-.034	.132	12.7	.79+06	.14+06	.27776-05
1723.39	170.6	.7	4.2	170.6	-1.654	.050	-.034	.129	12.5	.85+06	.15+06	.30267-05
1725.52	169.6	1.3	6.9	169.5	-1.663	.089	-.065	.128	12.4	.95+06	.17+06	.33780-05
1727.47	169.6	1.2	6.7	169.5	-1.662	.082	-.070	.118	12.1	.10+07	.18+06	.36637-05
1730.87	169.2	.2	.9	169.2	-1.635	.074	-.006	.143	11.5	.11+07	.20+06	.40676-05
1732.99	169.0	.3	1.7	169.0	-1.633	.084	.040	.136	11.2	.11+07	.21+06	.43274-05
1735.12	169.2	1.1	5.6	169.1	-1.633	.068	-.029	.147	10.9	.12+07	.23+06	.46767-05
1737.29	169.1	1.0	5.4	169.1	-1.629	.070	-.067	.140	10.6	.12+07	.24+06	.50062-05
1740.47	168.9	1.1	5.8	168.7	-1.622	.090	-.026	.141	10.1	.13+07	.26+06	.55536-05
1742.90	168.6	.4	1.9	168.6	-1.619	.096	-.006	.141	9.4	.13+07	.27+06	.55230-05
1744.72	169.4	.7	3.5	169.4	-1.622	.073	-.019	.141	9.5	.13+07	.29+06	.63715-05
1746.84	169.4	.5	2.5	169.5	-1.622	.072	-.006	.139	9.2	.14+07	.30+06	.67461-05
1750.04	169.8	-.2	-1.0	169.8	-1.622	.078	.015	.129	8.9	.15+07	.33+06	.75970-05
1752.16	170.2	.2	1.4	170.1	-1.622	.078	.004	.124	8.5	.14+07	.35+06	.81632-05
1754.30	170.4	-.1	-.7	170.4	-1.622	.076	.019	.121	8.2	.16+07	.37+06	.86483-05
1756.44	171.4	.0	.2	171.4	-1.626	.047	.012	.121	7.8	.16+07	.39+06	.92046-05
1759.64	171.6	1.0	6.5	171.5	-1.625	.071	-.055	.093	7.4	.17+07	.42+06	.10295-04
1761.76	173.4	-.1	-1.2	173.4	-1.631	.033	-.010	.095	7.1	.17+07	.44+06	.10718-04
1766.90	173.7	.7	6.7	173.7	-1.630	.028	-.043	.078	6.5	.19+07	.52+06	.12899-04
1769.70	173.9	.6	5.5	173.9	-1.629	.031	-.097	.067	6.2	.20+07	.56+06	.13820-04
1771.72	171.9	-.8	-5.3	171.9	-1.629	.082	-.011	.091	5.9	.21+07	.56+06	.15726-04
1773.65	171.8	-.3	-2.7	171.7	-1.618	.086	-.026	.089	5.6	.22+07	.69+06	.17906-04
1775.64	172.7	.4	3.5	172.7	-1.623	.072	-.050	.073	5.4	.23+07	.75+06	.18329-04
1778.56	173.5	1.0	8.7	173.4	-1.625	.045	-.056	.077	5.0	.24+07	.85+06	.20893-04
1780.90	173.7	1.1	9.7	173.6	-1.625	.046	-.068	.062	4.8	.25+07	.93+06	.22736-04
1783.68	172.9	-.2	-1.4	172.9	-1.619	.072	-.010	.080	4.4	.28+07	.11+07	.26680-04
1785.89	174.8	.9	10.2	174.7	-1.629	.024	-.028	.070	4.2	.29+07	.12+07	.29839-04
1787.97	175.5	1.6	17.3	175.3	-1.618	.015	-.030	.061	3.9	.31+07	.14+07	.33156-04
1790.11	175.0	1.0	11.6	174.9	-1.611	.039	-.063	.053	3.7	.31+07	.15+07	.35787-04
1795.45	174.3	.1	1.2	174.3	-1.601	.050	-.021	.044	3.1	.36+07	.21+07	.46174-04
1797.57	174.0	-.2	-1.8	174.0	-1.590	.045	.008	.044	2.9	.35+07	.24+07	.51069-04
1799.71	175.9	-1.1	-14.7	175.7	-1.596	.037	.042	.039	2.7	.35+07	.28+07	.59301-04
1802.96	175.8	.2	2.8	175.8	-1.599	.031	-.006	.053	2.4	.36+07	.32+07	.63979-04
1805.17	175.5	-1.2	-14.5	175.4	-1.603	.036	.033	.051	2.2	.37+07	.37+07	.69976-04
1807.29	175.0	-.7	-8.5	174.8	-1.603	.060	.020	.041	2.1	.38+07	.43+07	.77107-04
1809.42	174.9	-.3	-3.3	174.8	-1.600	.027	.073	.048	1.9	.39+07	.49+07	.83961-04
1812.56	173.7	.3	2.5	173.7	-1.596	.030	-.012	.090	1.8	.41+07	.62+07	.97324-04
1814.68	172.9	-.3	-2.6	172.9	-1.591	.036	.028	.096	1.6	.40+07	.71+07	.10448-03

TABLE IX. - SUMMARY OF AERODYNAMIC DATA FOR GEMINI XI

$T - T_R$, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	Re	Re_{2D}	ρ_∞
1385.35	167.4	.7	3.0	167.4	-1.496	.151	.161	.074	29.1	.48+04	.34+03	.61035-08 *
1387.28	166.6	1.1	4.5	166.6	-1.492	.049	-.018	.202	31.1	.68+04	.42+03	.75645-08
1390.20	165.2	1.8	6.8	165.1	-1.483	.080	.025	.206	29.9	.65+04	.44+03	.78730-08
1392.20	164.6	2.2	7.7	164.2	-1.477	.088	-.076	.200	28.6	.59+04	.43+03	.77345-08
1394.27	164.1	2.2	7.6	164.0	-1.476	.070	-.037	.230	28.9	.66+04	.47+03	.85282-08
1397.47	164.6	1.7	6.2	164.5	-1.479	-.007	-.001	.271	28.7	.74+04	.53+03	.95265-08
1399.43	165.3	1.7	6.7	165.3	-1.483	.122	.044	.172	29.0	.83+04	.59+03	.10525-07
1401.80	166.2	2.0	8.0	165.1	-1.489	.100	-.007	.178	28.5	.83+04	.61+03	.10972-07
1407.19	167.4	2.3	10.3	167.2	-1.496	.102	-.050	.149	27.0	.83+04	.65+03	.11905-07
1409.35	167.1	2.3	10.1	166.9	-1.495	.101	-.017	.161	26.9	.87+04	.70+03	.12609-07
1411.52	166.7	2.9	11.9	166.4	-1.492	.093	-.005	.238	28.8	.12+05	.86+03	.15640-07
1413.68	166.4	4.0	16.3	165.8	-1.490	.067	-.040	.197	28.3	.12+05	.91+03	.16387-07
1415.90	166.3	4.4	17.4	165.7	-1.490	.066	-.028	.205	28.7	.13+05	.97+03	.17625-07
1419.11	166.1	2.6	10.4	165.9	-1.489	.080	-.057	.183	28.6	.14+05	.11+04	.20406-07
1421.28	166.4	3.1	12.5	165.1	-1.490	.061	.002	.205	27.8	.15+05	.11+04	.20459-07
1423.40	168.0	5.1	22.9	167.0	-1.500	.030	-.104	.156	26.3	.18+05	.13+04	.23186-07
1428.79	168.6	-1.9	-9.1	168.4	-1.503	.063	.008	.141	27.8	.20+05	.15+04	.27176-07
1430.95	167.1	-1.5	-6.5	167.0	-1.494	.020	-.012	.214	27.4	.21+05	.15+04	.28733-07
1433.08	166.2	1.6	6.5	166.1	-1.499	.060	.043	.194	26.9	.20+05	.16+04	.29242-07
1435.25	166.7	3.7	15.3	166.2	-1.492	.060	-.004	.206	27.3	.23+05	.18+04	.32302-07
1437.41	167.9	3.0	13.8	167.5	-1.499	.059	-.058	.144	27.5	.25+05	.19+04	.35289-07
1440.60	169.4	-1.1	-6.0	169.3	-1.507	.069	-.019	.139	26.9	.24+05	.20+04	.37276-07
1442.72	168.7	-.4	-2.1	168.7	-1.503	.021	.055	.160	26.6	.27+05	.21+04	.39041-07
1444.88	167.4	2.5	11.2	167.2	-1.497	.033	-.002	.204	27.0	.30+05	.23+04	.42810-07
1447.03	166.8	4.2	17.5	166.2	-1.493	.051	-.073	.206	26.9	.32+05	.25+04	.45716-07
1450.23	167.9	1.4	6.3	167.9	-1.500	.059	-.054	.159	26.5	.33+05	.27+04	.48913-07
1452.33	169.0	-1.0	-5.3	168.9	-1.505	.062	-.001	.154	26.6	.36+05	.29+04	.52403-07
1454.50	168.9	-.1	-.8	168.9	-1.505	.005	.050	.162	26.3	.36+05	.30+04	.54700-07
1456.64	167.9	2.6	12.1	167.7	-1.500	.021	.022	.197	26.8	.43+05	.33+04	.59517-07
1459.89	167.3	3.0	13.0	167.0	-1.496	.072	-.058	.147	26.6	.45+05	.36+04	.65686-07
1461.96	168.8	-.3	-1.6	168.8	-1.504	.059	-.010	.156	26.8	.45+05	.39+04	.71270-07
1464.10	169.5	-.1	-.8	169.5	-1.507	.019	.027	.142	26.5	.50+05	.41+04	.74401-07
1466.27	168.6	2.4	11.7	168.4	-1.503	.015	.016	.190	26.3	.52+05	.43+04	.78089-07
1469.49	167.5	1.8	8.2	167.4	-1.497	.064	-.038	.173	26.3	.57+05	.47+04	.85891-07
1471.65	169.3	-.0	-.1	169.3	-1.506	.054	.007	.153	26.4	.62+05	.50+04	.92081-07
1473.78	169.8	1.8	5.7	169.6	-1.508	-.002	-.014	.174	26.6	.68+05	.56+04	.99756-07
1479.16	168.4	-.6	-3.3	168.4	-1.502	.075	.027	.150	25.7	.71+05	.59+04	.10912-06
1481.37	169.7	1.9	9.8	169.6	-1.508	.026	.016	.143	25.4	.71+05	.61+04	.11237-06
1483.46	168.6	2.4	11.4	168.4	-1.503	.026	-.035	.175	25.5	.76+05	.65+04	.11982-06
1485.62	167.9	.2	1.2	167.9	-1.499	.053	-.004	.178	25.5	.81+05	.69+04	.12737-06
1487.78	169.2	1.0	5.0	169.1	-1.506	.048	.028	.155	25.2	.82+05	.71+04	.13107-06
1491.01	168.6	1.4	6.8	168.5	-1.503	.025	-.042	.149	25.0	.87+05	.76+04	.14037-06
1493.13	168.1	.5	2.6	168.1	-1.501	.059	.023	.147	24.8	.89+05	.79+04	.14623-06
1495.30	169.9	2.5	13.9	169.6	-1.513	.031	-.012	.140	24.6	.91+05	.82+04	.15099-06
1497.47	169.6	1.9	10.4	169.4	-1.517	.019	-.036	.161	24.4	.94+05	.85+04	.15760-06
1500.68	168.6	2.1	12.6	168.4	-1.515	.032	.000	.162	24.1	.97+05	.90+04	.16501-06
1502.81	169.8	1.6	9.0	169.7	-1.527	.027	-.025	.158	23.9	.99+05	.93+04	.17126-06
1504.98	168.7	.6	2.9	168.7	-1.526	.023	.010	.192	23.8	.10+06	.97+04	.17987-06
1507.11	168.8	2.3	11.3	168.5	-1.528	.056	-.026	.141	23.9	.11+06	.10+05	.18938-06
1510.32	169.6	.1	.5	169.6	-1.531	.017	.022	.165	23.5	.11+06	.11+05	.19996-06
1512.48	168.6	2.0	10.1	168.4	-1.536	.067	-.011	.172	23.4	.11+06	.11+05	.20390-06
1514.62	169.4	1.0	5.5	169.4	-1.541	.035	-.011	.143	23.4	.12+06	.11+05	.21370-06
1516.78	169.4	1.6	8.7	169.3	-1.540	.023	.002	.176	23.5	.13+06	.12+05	.22501-06
1519.96	169.0	.5	2.8	169.0	-1.536	.052	-.001	.158	23.3	.14+06	.13+05	.24711-06
1522.13	169.5	1.9	10.0	169.3	-1.539	.022	-.008	.173	23.2	.14+06	.13+05	.24708-06
1524.30	168.6	1.5	7.5	168.5	-1.539	.050	-.017	.148	23.1	.14+06	.14+05	.25734-06
1525.42	169.7	1.4	7.5	169.6	-1.549	.033	.010	.149	23.0	.15+06	.14+05	.26520-06
1528.41	169.3	1.3	7.0	169.2	-1.549	.027	-.008	.171	22.9	.15+06	.15+05	.27613-06
1531.81	170.0	1.6	5.3	169.9	-1.554	.027	.015	.158	22.8	.15+06	.15+05	.28606-06
1533.99	168.7	1.2	6.1	168.7	-1.556	.031	-.018	.177	22.4	.14+06	.16+05	.29697-06
1536.10	169.3	1.5	8.2	169.2	-1.561	.049	.016	.158	22.2	.14+06	.16+05	.30031-06
1539.27	169.3	1.3	6.8	169.2	-1.566	.026	-.009	.173	22.0	.16+06	.16+05	.30767-06
1541.49	169.2	2.1	11.0	169.0	-1.569	.055	-.002	.150	21.7	.16+06	.17+05	.31817-06
1543.41	169.4	.8	4.6	169.4	-1.576	.031	.009	.147	21.5	.16+06	.17+05	.32617-06
1545.64	168.8	1.4	7.9	168.7	-1.577	.044	.004	.156	21.5	.17+06	.18+05	.33837-06
1548.72	170.6	-.1	-.6	170.6	-1.587	-.007	.128	.083	21.6	.18+06	.19+05	.35187-06
1550.62	167.3	2.4	11.5	167.0	-1.567	.111	.032	.194	21.4	.19+06	.20+05	.37086-06
1552.61	167.7	1.5	6.9	167.6	-1.567	.114	.002	.123	21.5	.19+06	.20+05	.38216-06
1555.73	168.5	2.7	12.9	168.2	-1.579	.094	.027	.144	21.2	.20+06	.21+05	.39716-06
1557.90	169.3	1.2	6.5	169.2	-1.586	.014	-.021	.176	21.1	.20+06	.21+05	.40944-06
1560.06	169.0	3.7	18.4	168.5	-1.587	.063	-.088	.134	21.0	.21+06	.22+05	.42400-06
1562.24	169.1	3.2	16.4	168.7	-1.596	.049	-.134	.108	20.9	.22+06	.23+05	.44440-06
1565.45	170.6	-.2	-1.2	170.6	-1.601	.009	-.020	.150	20.6	.22+06	.24+05	.46631-06
1567.61	170.0	2.4	13.5	169.7	-1.605	.041	-.104	.111	20.4	.23+06	.25+05	.48822-06

* -08 INDICATES AN EXPONENT OF 10^{-8}

TABLE IX. - SUMMARY OF AERODYNAMIC DATA FOR GEMINI XI - Concluded

$T - T_R$, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	Re	Re_{2D}	ρ_∞
1569.78	169.0	1.2	6.0	169.9	-1.602	.049	-.033	.159	20.1	.24+06	.26+05	.50383-06
1571.91	169.3	.1	.3	169.3	-1.606	.040	-.041	.151	20.3	.25+06	.28+05	.53106-06
1575.12	170.9	1.0	6.0	170.8	-1.617	.002	-.005	.159	19.9	.26+06	.29+05	.55445-06
1577.29	168.9	2.5	12.5	168.6	-1.610	.056	-.009	.145	19.7	.26+06	.29+05	.57089-06
1579.42	170.1	1.0	5.9	170.0	-1.622	.022	-.000	.152	19.5	.27+06	.30+05	.59035-06
1581.47	170.1	.0	.3	170.1	-1.624	.032	-.038	.142	19.5	.28+06	.32+05	.61799-06
1584.45	169.6	1.6	8.5	169.5	-1.620	.011	-.093	.126	19.2	.29+06	.34+05	.64549-06
1586.42	168.4	.7	3.5	168.4	-1.611	.075	-.076	.137	19.1	.30+06	.35+05	.67479-06
1589.48	167.7	1.6	7.5	167.6	-1.604	.067	-.078	.156	18.9	.31+06	.36+05	.70460-06
1591.38	169.7	1.4	7.5	169.6	-1.625	.041	-.058	.139	18.7	.31+06	.37+05	.73022-06
1593.47	169.5	.8	4.1	169.5	-1.626	.058	-.064	.131	18.6	.33+06	.39+05	.76758-06
1596.68	170.6	2.5	14.5	170.3	-1.636	-.012	-.094	.112	18.1	.33+06	.41+05	.80585-06
1598.85	170.7	1.7	10.3	170.6	-1.643	.038	-.054	.125	18.0	.35+06	.43+05	.95129-06
1601.02	[illegible]	1.9	5.5	169.5	-1.623	.072	-.069	.141	17.8	.37+06	.46+05	.90396-06
1603.18	171.4	1.8	11.4	171.2	-1.651	.009	-.100	.093	17.6	.38+06	.48+05	.95958-06
1606.36	170.2	.7	4.3	170.1	-1.643	.063	-.036	.128	17.4	.42+06	.51+05	.10469-05
1609.93	168.6	.0	.2	168.4	-1.676	.086	-.008	.149	17.3	.44+06	.54+05	.11130-05
1610.70	170.7	.8	3.1	170.6	-1.651	.018	.018	.149	16.9	.44+06	.58+05	.11511-05
1612.87	171.1	2.2	13.7	170.9	-1.659	.030	-.019	.149	16.6	.45+06	.60+05	.12052-05
1614.98	170.4	2.1	12.3	170.2	-1.655	.045	-.042	.135	16.5	.48+06	.64+05	.12798-05
1619.17	170.2	1.7	9.7	170.1	-1.654	.055	-.075	.141	16.1	.50+06	.68+05	.13561-05
1620.30	170.8	1.3	8.1	170.7	-1.665	.031	-.011	.144	15.8	.51+06	.71+05	.14397-05
1622.46	171.2	1.8	11.2	171.0	-1.672	.026	-.030	.136	15.6	.52+06	.75+05	.14993-05
1624.61	171.0	1.5	9.2	170.9	-1.673	.025	-.021	.130	15.3	.54+06	.78+05	.15630-05
1627.56	170.3	1.3	7.3	170.2	-1.647	.078	-.122	.086	15.1	.57+06	.86+05	.14818-05
1632.61	169.9	.2	1.0	169.9	-1.666	.060	-.036	.137	14.5	.62+06	.96+05	.18029-05
1634.90	170.8	.4	2.7	170.9	-1.673	.041	-.059	.119	14.3	.63+06	.98+05	[illegible]
1637.92	171.2	1.8	11.3	171.0	-1.675	.021	-.074	.110	13.9	.66+06	.11+06	.20996-05
1639.69	171.0	1.9	12.1	170.8	-1.669	.037	-.066	.117	13.8	.70+06	.11+06	.22620-05
1641.02	170.1	1.7	9.8	170.0	-1.659	.065	-.055	.124	13.7	.76+06	.12+06	.24537-05
1643.98	170.2	1.4	8.2	170.1	-1.658	.075	-.075	.110	13.4	.81+06	.13+06	.26518-05
1647.14	170.6	1.7	9.9	170.5	-1.661	.062	-.057	.117	13.0	.88+06	.15+06	.29737-05
1649.75	171.1	2.7	13.9	170.9	-1.663	.041	-.053	.120	12.8	.94+06	.16+06	.32608-05
1651.42	172.2	1.7	12.2	172.0	-1.672	.013	-.060	.103	12.4	.99+06	.17+06	.34963-05
1653.98	172.3	1.1	8.1	172.2	-1.668	.026	-.079	.091	12.1	.10+07	.19+06	.37331-05
1656.76	172.3	.8	6.0	172.3	-1.664	.009	-.028	.118	11.5	.11+07	.20+06	.41496-05
1658.93	172.2	.8	6.0	172.2	-1.657	.010	.016	.124	11.2	.11+07	.22+06	.44675-05
1661.06	171.6	1.3	8.7	171.5	-1.649	.036	.001	.129	10.9	.12+07	.23+06	.48083-05
1663.22	170.3	.6	3.5	170.3	-1.637	.063	.002	.132	10.7	.13+07	.26+06	.53297-05
1665.38	170.9	1.1	6.5	170.9	-1.637	.053	-.005	.135	10.3	.13+07	.27+06	.56710-05
1669.57	170.8	1.3	7.9	170.7	-1.636	.058	-.021	.127	9.8	.14+07	.29+06	.62143-05
1670.70	171.1	.7	4.3	171.0	-1.632	.056	-.002	.126	9.5	.15+07	.31+06	.67613-05
1672.02	171.1	1.3	8.4	171.0	-1.631	.060	-.021	.119	9.2	.15+07	.32+06	.72264-05
1674.98	171.7	.7	4.9	171.7	-1.633	.044	-.007	.118	8.9	.16+07	.34+06	.77138-05
1678.17	172.6	1.2	9.0	172.5	-1.634	.031	-.008	.111	8.6	.16+07	.36+06	.84557-05
1680.33	173.3	.9	7.6	173.2	-1.635	.019	-.008	.106	8.1	.17+07	.38+06	.89872-05
1682.46	173.5	.6	3.6	173.5	-1.634	.020	-.001	.101	7.8	.17+07	.42+06	.94526-05
1684.62	172.8	.6	3.5	172.8	-1.630	.043	.001	.099	7.5	.18+07	.42+06	.10279-04
1687.02	172.0	-.5	-3.7	172.0	-1.626	.071	.027	.093	7.0	.18+07	.46+06	.11122-04
1689.04	173.7	1.1	10.1	173.6	-1.639	.029	-.016	.093	6.8	.19+07	.49+06	.12036-04
1692.98	174.5	1.7	17.1	174.2	-1.631	.010	-.029	.083	6.5	.19+07	.53+06	.12928-04
1694.25	173.6	1.1	9.7	173.5	-1.628	.036	-.013	.091	6.2	.19+07	.55+06	.13509-04
1697.47	172.8	.7	5.8	172.7	-1.624	.061	-.009	.090	5.8	.20+07	.62+06	.14887-04
1699.99	174.2	.6	5.5	174.2	-1.629	.026	-.001	.086	5.5	.20+07	.66+06	.15788-04
1701.71	175.1	.6	6.6	175.0	-1.631	.005	-.007	.083	5.2	.20+07	.69+06	.16664-04
1703.85	174.1	.9	8.2	174.1	-1.627	.039	-.008	.086	5.0	.20+07	.72+06	.17575-04
1707.94	173.3	.3	2.6	173.3	-1.623	.060	-.000	.080	4.7	.21+07	.80+06	.18503-04
1709.19	175.0	.0	.1	175.0	-1.626	.019	.013	.073	4.5	.22+07	.84+06	.20911-04
1711.35	175.0	.5	6.6	175.0	-1.625	.007	-.001	.070	4.2	.22+07	.91+06	.22468-04
1713.60	175.9	1.6	19.1	175.7	-1.621	.003	-.016	.065	4.0	.23+07	.10+07	.24127-04
1716.70	174.4	.7	2.5	174.4	-1.611	.056	.016	.066	3.8	.25+07	.12+07	.27446-04
1718.03	175.5	1.1	13.9	175.4	-1.611	.026	-.003	.056	3.6	.25+07	.13+07	.29857-04
1722.95	176.2	2.5	33.0	175.5	-1.609	-.007	-.036	.056	3.4	.25+07	.16+07	.31509-04
1724.15	175.9	.3	4.6	175.9	-1.606	.016	.069	.065	3.6	.26+07	.18+07	.39081-04
1729.08	176.5	.9	15.0	176.4	-1.597	-.003	.019	.053	2.9	.28+07	.19+07	.41838-04
1731.10	174.6	.7	1.5	174.4	-1.593	.080	.011	.062	2.6	.29+07	.23+07	.47040-04
1733.00	174.3	.5	4.5	174.3	-1.595	.050	.019	.061	2.5	.30+07	.25+07	.50649-04
1735.02	174.8	.6	6.6	174.8	-1.590	.056	.072	.056	2.4	.31+07	.28+07	.56457-04
1737.06	174.6	.9	8.0	174.9	-1.600	.050	-.001	.044	2.2	.32+07	.33+07	.61397-04
1739.06	174.6	.7	7.0	174.3	-1.601	.060	.022	.053	2.1	.33+07	.37+07	.66192-04
1742.00	173.7	-.0	-.1	173.7	-1.597	.066	.064	.065	1.9	.34+07	.45+07	.79632-04
1744.00	173.5	.0	.2	173.5	-1.599	.058	.064	.057	1.8	.35+07	.51+07	.81660-04
1747.90	174.0	-.6	-4.0	174.0	-1.596	-.004	.070	.068	1.7	.37+07	.62+07	[illegible]

TABLE X. - SUMMARY OF AERODYNAMIC DATA FOR GEMINI XII

$T - T_R$, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	Re	Re_{2D}	ρ_∞
1362.12	168.5	-.5	-2.5	168.5	-1.502	.106	-.003	.133	29.6	.51+04	.35+03	.62935-08*
1364.98	165.5	-2.0	-7.9	165.4	-1.495	.003	-.015	.249	29.1	.53+04	.38+03	.59145-08
1366.91	165.4	-.5	-2.1	165.4	-1.486	.020	.013	.244	28.3	.54+04	.39+03	.71172-08
1369.78	169.7	1.3	7.0	169.6	-1.508	.114	.019	.104	28.5	.62+04	.45+03	.81342-08
1371.79	172.7	1.8	14.0	172.4	-1.520	.138	-.057	.036	28.4	.57+04	.49+03	.87989-08
1373.97	174.6	2.5	25.2	174.0	-1.525	.084	-.072	.031	28.2	.71+04	.52+03	.94518-08
1377.18	173.9	4.0	33.4	172.7	-1.524	.007	.015	.117	27.1	.69+04	.55+03	.98734-08
1379.29	170.9	4.7	27.1	169.8	-1.514	.095	.020	.114	26.6	.70+04	.57+03	.10311-07
1381.47	171.3	4.6	27.8	170.2	-1.515	.173	-.054	.053	26.7	.77+04	.62+03	.11246-07
1383.60	173.2	4.5	33.7	171.9	-1.522	.086	-.035	.091	26.7	.82+04	.67+03	.12123-07
1386.81	175.3	2.3	25.8	174.9	-1.526	.015	.074	.042	25.9	.78+04	.69+03	.12609-07
1388.97	172.4	-1.4	-10.5	172.3	-1.519	-.007	.017	.122	25.8	.87+04	.75+03	.13576-07
1391.00	166.8	-4.6	-18.8	165.1	-1.493	.043	-.021	.214	26.4	.10+05	.85+03	.15398-07
1393.15	160.9	-5.6	-15.7	159.2	-1.449	.067	.021	.327	25.9	.10+05	.88+03	.15892-07
1396.35	156.2	-2.2	-5.0	156.1	-1.39[illegible]	.123	.057	.331	25.0	.12+05	.99+03	.17916-07
1398.47	159.5	2.3	6.0	159.4	-1.436	.105	-.005	.295	25.9	.12+05	.11+04	.18161-07
1400.56	165.8	5.9	22.3	164.7	-1.487	.093	-.035	.233	25.5	.13+05	.11+04	.19956-07
1402.71	171.6	7.1	39.4	169.0	-1.515	.074	-.038	.139	25.6	.13+05	.12+04	.21505-07
1405.92	173.4	3.1	25.1	172.7	-1.522	-.015	-.033	.195	25.3	.15+05	.13+04	.23683-07
1408.09	168.1	-1.4	-6.6	168.0	-1.500	.040	-.001	.185	25.2	.15+05	.14+04	.24912-07
1410.16	161.3	-4.2	-12.3	160.9	-1.453	.063	-.004	.290	25.4	.17+05	.15+04	.27092-07
1412.31	158.3	-3.4	-8.5	158.1	-1.422	.107	.038	.312	26.2	.21+05	.17+04	.31007-07
1415.48	164.7	3.0	10.7	164.4	-1.479	.094	-.008	.211	24.8	.25+05	.20+04	.36458-07
1417.60	171.2	4.8	28.6	170.0	-1.519	.044	-.039	.138	24.6	.26+05	.21+04	.39012-07
1419.78	172.1	2.4	16.7	171.8	-1.519	.029	-.015	.123	26.5	.28+05	.23+04	.41817-07
1421.89	167.0	-1.5	-6.7	166.9	-1.494	.000	-.009	.224	26.3	.29+05	.26+04	.44135-07
1425.07	159.3	-2.4	-6.3	159.1	-1.432	.132	.032	.274	26.2	.33+05	.27+04	.49245-07
1427.14	164.3	2.1	7.4	164.2	-1.477	.096	-.002	.271	26.2	.35+05	.29+04	.52604-07
1429.31	171.2	4.0	24.5	170.4	-1.515	.015	-.015	.131	26.4	.35+05	.32+04	.57826-07
1432.46	168.0	-1.6	-7.7	167.9	-1.500	-.002	.013	.204	26.2	.42+05	.35+04	.63503-07
1434.63	161.6	-2.2	-6.7	161.5	-1.456	.081	.014	.273	26.1	.45+05	.37+04	.67950-07
1436.73	162.9	1.7	5.6	162.8	-1.467	.131	-.036	.211	26.3	.50+05	.41+04	.74239-07
1442.03	168.1	-2.0	-5.5	168.0	-1.501	-.022	.031	.186	25.4	.52+05	.45+04	.82478-07
1444.16	162.4	-.2	-.6	162.4	-1.462	.078	.014	.250	25.3	.55+05	.48+04	.87791-07
1445.28	165.0	3.4	13.2	164.6	-1.481	.073	-.036	.217	25.1	.57+05	.50+04	.92029-07
1448.42	170.8	2.0	12.2	170.6	-1.511	-.001	-.038	.149	25.0	.59+05	.53+04	.97102-07
1451.63	164.6	-1.5	-5.3	164.5	-1.479	.061	.060	.271	24.6	.62+05	.57+04	.10379-06
1453.75	163.8	3.0	10.3	163.6	-1.489	.086	-.023	.232	24.7	.67+05	.61+04	.11158-06
1455.88	169.5	1.4	8.7	169.3	-1.517	.032	-.027	.160	25.3	.79+05	.65+04	.12515-06
1458.02	169.8	-1.0	-5.3	169.8	-1.504	.019	.027	.174	25.1	.81+05	.71+04	.13116-06
1461.23	163.4	4.3	14.4	163.1	-1.472	.115	-.068	.207	24.8	.85+05	.77+04	.14110-06
1463.35	169.1	-.5	-2.7	169.0	-1.508	.032	.007	.171	24.8	.92+05	.82+04	.15054-06
1465.48	167.8	.6	2.7	167.8	-1.502	.036	.003	.192	24.7	.96+05	.86+04	.15926-06
1467.62	164.5	3.2	11.4	164.2	-1.484	.099	-.051	.233	24.5	.99+05	.90+04	.16604-06
1470.79	170.4	-1.7	-10.0	170.5	-1.522	-.020	.070	.119	24.0	.10+06	.96+04	.17617-06
1472.91	165.7	3.1	12.2	165.4	-1.506	.062	-.060	.239	23.7	.10+06	.97+04	.17893-06
1475.04	164.2	-.2	-.9	164.2	-1.514	.070	.005	.197	23.5	.10+06	.10+05	.18512-06
1477.18	168.0	.1	.5	168.0	-1.531	.034	.019	.185	23.3	.11+06	.10+05	.19361-06
1480.39	163.9	.1	.4	163.9	-1.501	.120	-.008	.188	23.3	.12+06	.11+05	.20831-06
1482.47	169.3	1.0	5.3	169.2	-1.561	.018	-.011	.175	22.9	.12+06	.11+05	.21279-06
1484.61	166.5	1.5	6.2	166.4	-1.531	.055	-.019	.202	22.9	.12+06	.12+05	.22316-06
1486.77	166.5	1.3	5.4	166.4	-1.531	.069	-.017	.194	22.8	.13+06	.13+05	.23393-06
1489.95	167.7	1.3	6.1	167.6	-1.541	.019	-.034	.194	22.5	.13+06	.13+05	.24521-06
1492.07	166.[illegible]	1.0	4.2	166.5	-1.539	.061	-.008	.199	22.5	.13+06	.14+05	.25[illegible]09-06
1494.20	169.2	1.6	7.3	169.2	-1.569	.013	-.017	.176	22.3	.14+06	.14+05	.26606-06
1496.39	168.1	1.5	7.0	168.0	-1.555	.034	-.026	.184	22.2	.14+06	.15+05	.27316-06
1498.57	170.5	1.1	6.3	170.4	-1.574	-.031	-.026	.163	21.9	.15+06	.15+05	.28441-06
1501.64	166.1	1.6	5.5	166.0	-1.546	.076	-.010	.194	22.0	.14+06	.16+05	.30264-06
1503.76	169.0	.9	4.0	169.0	-1.547	.025	-.006	.178	21.9	.14+06	.17+05	.31003-06
1505.91	169.2	1.3	6.2	169.2	-1.545	.040	-.023	.179	21.8	.16+06	.17+05	.32387-06
1509.11	170.2	-.5	-3.1	170.2	-1.589	-.003	.036	.151	21.6	.17+06	.18+05	.34081-06
1511.23	166.2	1.7	4.9	166.1	-1.577	.080	-.022	.109	21.7	.18+06	.19+05	.35604-06
1513.36	168.9	.2	1.2	168.9	-1.576	.024	.019	.178	21.4	.18+06	.19+05	.36336-06
1515.51	169.0	.1	.3	169.0	-1.572	.041	.012	.178	21.4	.19+06	.20+05	.37706-06
1518.44	170.6	1.1	6.8	170.5	-1.591	-.025	.003	.141	21.1	.19+06	.21+05	.39159-06
1520.80	166.[illegible]	-.3	[illegible]	166.1	-1.561	.000	.029	.188	21.2	.20+06	.22+05	.41173-06
1522.93	169.4	2.1	11.3	169.2	-1.587	.011	-.042	.143	21.0	.20+06	.22+05	.42032-06
1525.90	168.7	2.0	5.8	168.5	-1.587	.034	-.026	.175	20.8	.21+06	.23+05	.42997-06
1528.11	169.7	.5	2.9	169.7	-1.587	-.006	.006	.170	20.7	.21+06	.23+05	.44699-06
1530.09	167.1	.7	2.0	167.1	-1.580	.003	.024	.165	20.7	.22+06	.24+05	.46570-06
1533.11	170.3	.6	2.2	170.3	-1.604	-.000	.048	.149	20.3	.22+06	.25+05	.47279-06
1535.00	166.4	1.6	6.8	166.3	-1.570	.129	.021	.141	20.3	.23+06	.25+05	.48001-06

* -08 INDICATES AN EXPONENT OF 10^{-8}

TABLE X. - SUMMARY OF AERODYNAMIC DATA FOR GEMINI XII - Concluded

$T - T_R$, sec	α, deg	β, deg	Φ_A, deg	α_T, deg	C_A	C_N	C_Y	L/D	M_∞	Re	Re_{2D}	ρ_∞
1538.03	169.6	2.0	11.0	169.4	-1.608	.015	.010	.175	20.2	.24+06	.27+05	.51195-06
1540.00	167.2	1.9	8.1	167.1	-1.589	.077	-.001	.179	20.4	.26+06	.28+05	.53934-06
1542.12	168.2	.6	3.0	168.2	-1.595	.061	.056	.156	20.3	.27+06	.29+05	.56091-06
1545.23	165.7	2.4	5.3	165.5	-1.572	.138	-.012	.166	20.2	.28+06	.31+05	.59858-06
1547.35	168.2	1.2	5.8	168.1	-1.598	.048	.004	.179	19.8	.28+06	.31+05	.60870-06
1549.48	167.8	.9	4.4	167.7	-1.609	.069	-.004	.173	19.6	.28+06	.32+05	.62627-06
1551.57	167.3	-.9	-4.0	157.2	-1.597	.092	.068	.152	19.4	.29+06	.33+05	.64976-06
1554.52	168.1	2.1	9.7	167.9	-1.606	.078	-.019	.163	19.1	.30+06	.35+05	.67766-06
1556.49	169.0	1.0	5.0	169.0	-1.618	.064	.033	.149	19.0	.31+06	.36+05	.70110-06
1559.51	170.0	.7	4.3	170.0	-1.628	.033	.065	.139	18.9	.33+06	.38+05	.75036-06
1561.86	168.0	.2	1.1	168.0	-1.609	.080	.058	.149	18.8	.35+06	.40+05	.79099-06
1563.69	167.7	1.3	5.8	167.6	-1.606	.098	.041	.151	18.6	.36+06	.42+05	.82367-06
1565.87	167.3	2.2	5.7	167.2	-1.603	.100	-.004	.163	18.3	.37+06	.44+05	.87713-06
1569.03	167.5	2.1	5.2	167.3	-1.607	.083	-.020	.170	18.0	.38+06	.46+05	.91374-06
1571.16	169.1	1.9	5.3	168.9	-1.627	.040	-.021	.167	17.7	.39+06	.48+05	.95333-06
1573.29	168.7	1.2	5.9	168.7	-1.626	.054	-.006	.165	17.6	.41+06	.51+05	.10117-05
1576.46	169.4	1.5	8.1	169.3	-1.634	.024	-.038	.161	17.2	.42+06	.54+05	.10762-05
1578.63	169.2	1.1	5.7	169.1	-1.636	.041	-.021	.163	16.9	.43+06	.56+05	.11252-05
1580.76	167.5	-.5	-2.6	167.5	-1.615	.094	.031	.158	16.8	.46+06	.60+05	.11900-05
1582.89	168.9	-.2	-.9	168.9	-1.636	.046	.035	.150	16.5	.46+06	.61+05	.12288-05
1586.07	170.4	1.4	8.4	170.3	-1.656	-.009	-.025	.155	16.0	.46+06	.64+05	.12888-05
1588.19	170.5	1.6	5.2	170.4	-1.662	.003	-.029	.152	15.8	.48+06	.67+05	.13469-05
1590.16	168.0	1.2	5.7	167.9	-1.629	.087	-.043	.153	15.8	.51+06	.72+05	.14378-05
1593.19	168.0	1.4	6.4	167.9	-1.630	.086	-.040	.156	15.5	.54+06	.76+05	.15296-05
1595.08	169.4	1.3	7.2	169.4	-1.654	.034	-.038	.156	15.2	.54+06	.74+05	.15706-05
1597.09	170.1	1.4	7.8	170.0	-1.666	.013	-.039	.150	15.0	.55+06	.81+05	.16351-05
1600.01	169.0	1.5	7.6	168.9	-1.652	.062	-.031	.152	14.8	.58+06	.87+05	.17550-05
1602.06	168.2	1.7	6.3	168.1	-1.638	.092	-.031	.150	14.7	.62+06	.93+05	.18665-05
1605.24	168.3	1.6	7.5	168.2	-1.638	.099	-.021	.146	14.3	.65+06	.10+06	.20190-05
1607.38	169.3	1.7	8.7	169.2	-1.652	.068	-.015	.148	13.9	.66+06	.11+06	.21011-05
1609.42	170.9	1.2	7.2	170.8	-1.668	.030	-.029	.137	13.6	.68+06	.11+06	.22313-05
1612.44	171.2	.8	5.1	171.2	-1.669	.022	-.020	.137	13.3	.74+06	.12+06	.24830-05
1614.27	169.2	.7	3.9	169.2	-1.644	.095	-.018	.137	13.1	.79+06	.13+06	.26706-05
1616.35	169.1	.9	4.7	169.0	-1.641	.095	-.040	.129	12.9	.83+06	.14+06	.28618-05
1619.29	168.7	.5	2.6	168.7	-1.635	.095	-.028	.138	12.6	.92+06	.16+06	.32332-05
1621.25	170.2	.6	3.7	170.2	-1.650	.047	-.034	.135	12.3	.96+06	.17+06	.36555-05
1624.32	169.4	1.4	7.4	169.3	-1.639	.059	-.044	.143	11.9	.10+07	.19+06	.38509-05
1626.22	170.8	1.4	8.3	170.8	-1.659	.010	-.035	.140	11.6	.11+07	.20+06	.40675-05
1629.29	170.7	.2	1.2	170.7	-1.646	.019	.006	.152	11.4	.11+07	.21+06	.44085-05
1631.45	169.7	1.4	7.8	169.7	-1.637	.055	.012	.147	11.0	.13+07	.24+06	.50315-05
1633.57	169.1	.6	3.1	169.1	-1.629	.068	.010	.150	10.7	.13+07	.27+06	.55150-05
1635.74	170.0	-.3	-1.7	170.0	-1.634	.048	.029	.141	10.4	.14+07	.28+06	.60365-05
1637.86	170.3	.4	3.3	170.3	-1.633	.066	.024	.127	10.1	.15+07	.31+06	.66715-05
1641.05	169.7	1.5	8.3	169.6	-1.627	.068	-.036	.135	9.6	.17+07	.34+06	.76001-05
1643.18	169.1	1.3	6.7	169.0	-1.619	.084	-.030	.137	9.2	.17+07	.37+06	.82540-05
1645.30	169.5	.7	3.9	169.5	-1.620	.081	-.001	.134	8.8	.18+07	.39+06	.89081-05
1647.46	170.4	.8	4.9	170.4	-1.624	.067	.003	.128	8.5	.19+07	.41+06	.95980-05
1650.53	171.7	1.3	6.6	171.6	-1.629	.038	-.015	.122	7.9	.20+07	.45+06	.10693-04
1652.54	172.0	1.3	5.3	171.9	-1.629	.051	-.007	.110	7.6	.20+07	.47+06	.11487-04
1655.56	172.2	1.0	7.3	172.1	-1.627	.060	.001	.102	7.2	.21+07	.52+06	.12809-04
1657.46	172.0	.8	5.8	172.0	-1.625	.066	.009	.099	6.9	.22+07	.55+06	.13718-04
1660.44	172.4	1.2	5.0	172.3	-1.625	.058	-.008	.098	6.4	.23+07	.63+06	.15392-04
1662.37	172.4	1.1	7.9	172.4	-1.623	.058	-.006	.098	6.2	.24+07	.69+06	.16667-04
1664.35	172.8	.9	7.4	172.8	-1.629	.062	.001	.088	5.9	.25+07	.73+06	.18006-04
1667.29	172.6	.6	4.2	172.5	-1.622	.078	.014	.081	5.4	.26+07	.83+06	.20391-04
1669.30	173.2	.0	.0	173.2	-1.626	.068	.036	.071	5.1	.27+07	.91+06	.22208-04
1672.32	173.2	.9	7.6	173.2	-1.624	.068	.006	.077	4.7	.29+07	.11+07	.25729-04
1674.22	173.6	.6	5.0	173.6	-1.622	.066	.019	.070	4.5	.30+07	.12+07	.28106-04
1677.24	173.8	1.0	5.6	173.7	-1.618	.083	.006	.071	4.1	.32+07	.14+07	.32491-04
1679.14	173.7	.9	8.2	173.7	-1.619	.067	.010	.071	3.9	.33+07	.15+07	.35703-04
1681.12	174.3	.6	5.8	174.3	-1.608	.053	.017	.065	3.7	.34+07	.17+07	.38798-04
1684.04	174.9	1.0	11.3	174.8	-1.605	.077	.009	.063	3.3	.34+07	.19+07	.43687-04
1689.09	175.9	.3	4.3	175.9	-1.602	.030	-.002	.047	2.8	.38+07	.26+07	.55273-04
1690.98	176.7	.2	3.7	176.7	-1.599	.020	.001	.046	2.6	.39+07	.30+07	.61612-04
1694.00	175.3	-.2	-2.4	175.3	-1.598	.064	.039	.035	2.4	.40+07	.36+07	.70684-04
1695.90	175.3	.5	6.7	175.3	-1.603	.055	.037	.041	2.7	.42+07	.42+07	.77884-04
1697.86	175.5	1.8	22.1	175.2	-1.605	.037	.016	.059	2.1	.43+07	.48+07	.85522-04
1700.81	173.2	3.2	25.1	172.5	-1.596	.053	.002	.097	1.9	.46+07	.61+07	.99139-04
1702.79	171.4	3.1	19.5	170.9	-1.589	.054	-.009	.125	1.8	.47+07	.72+07	.10951-03
1705.89	169.8	.5	2.6	169.8	-1.581	.029	-.036	.152	1.6	.48+07	.91+07	.12514-03
1707.93	169.1	.1	.6	169.1	-1.570	.053	-.014	.196	1.5	.48+07	.10+08	.13452-03

$$C_{NR} = \sqrt{C_Y^{\ 2} + C_N^{\ 2}}$$

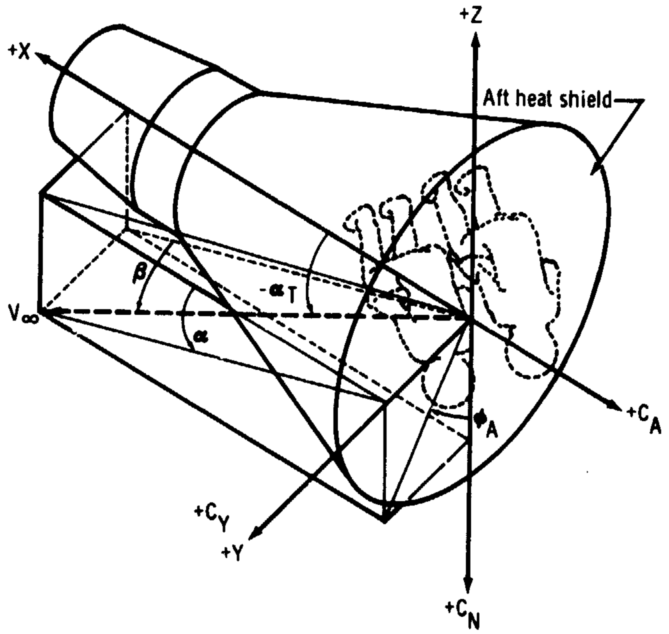

Figure 1. - Relationship of aerodynamic angles and coefficients to body axes.

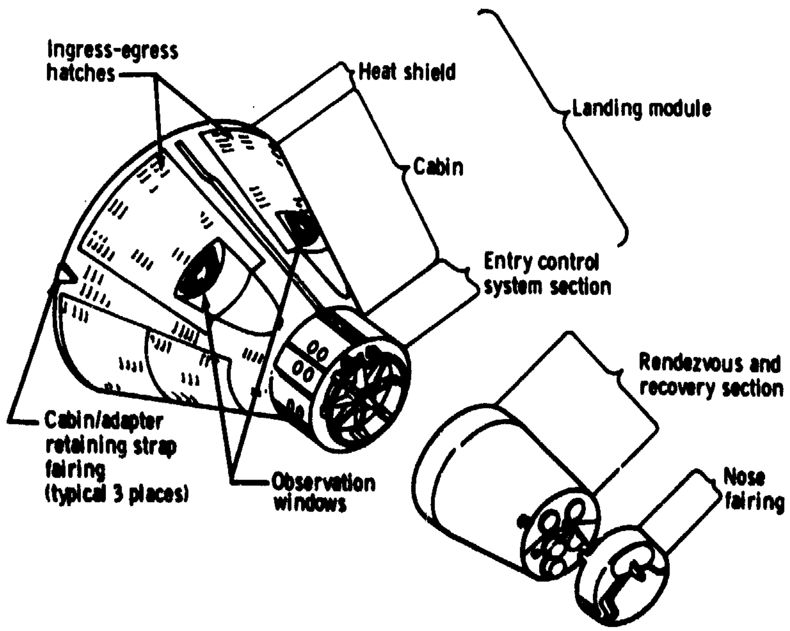

Figure 2. - Gemini entry module configuration.

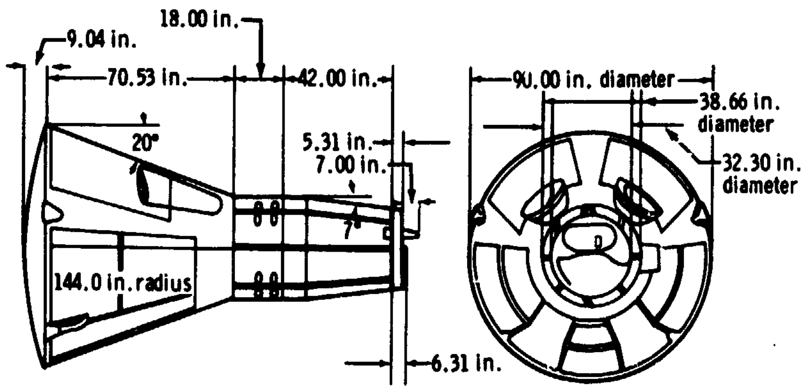

Figure 3. - Gemini entry module dimensions.

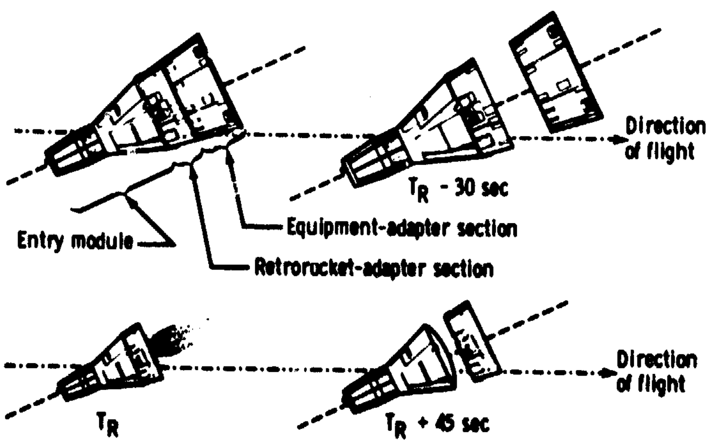

Figure 4. - Retrograde sequence.

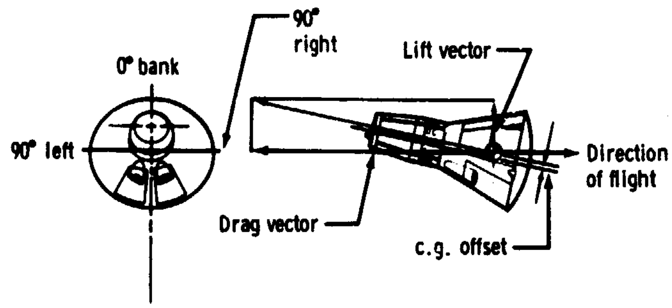

Figure 5. - Entry vehicle trim.

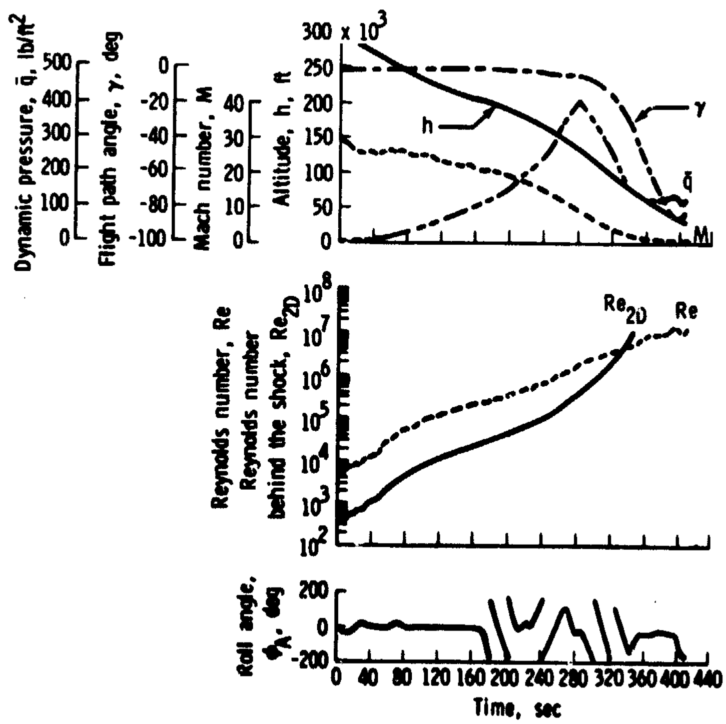

Figure 6. - Entry parameters for a typical Gemini mission (Gemini XII).

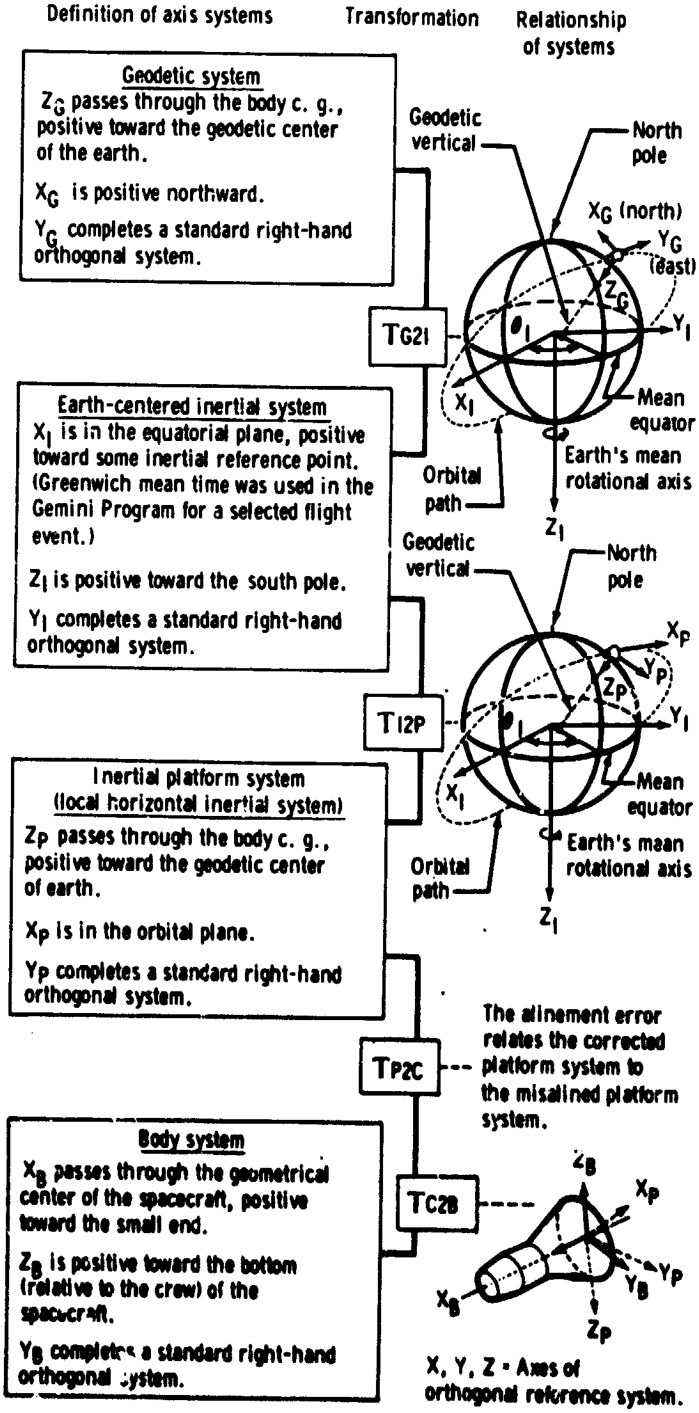

Figure 7. - Axis system definitions showing transformation relationships.

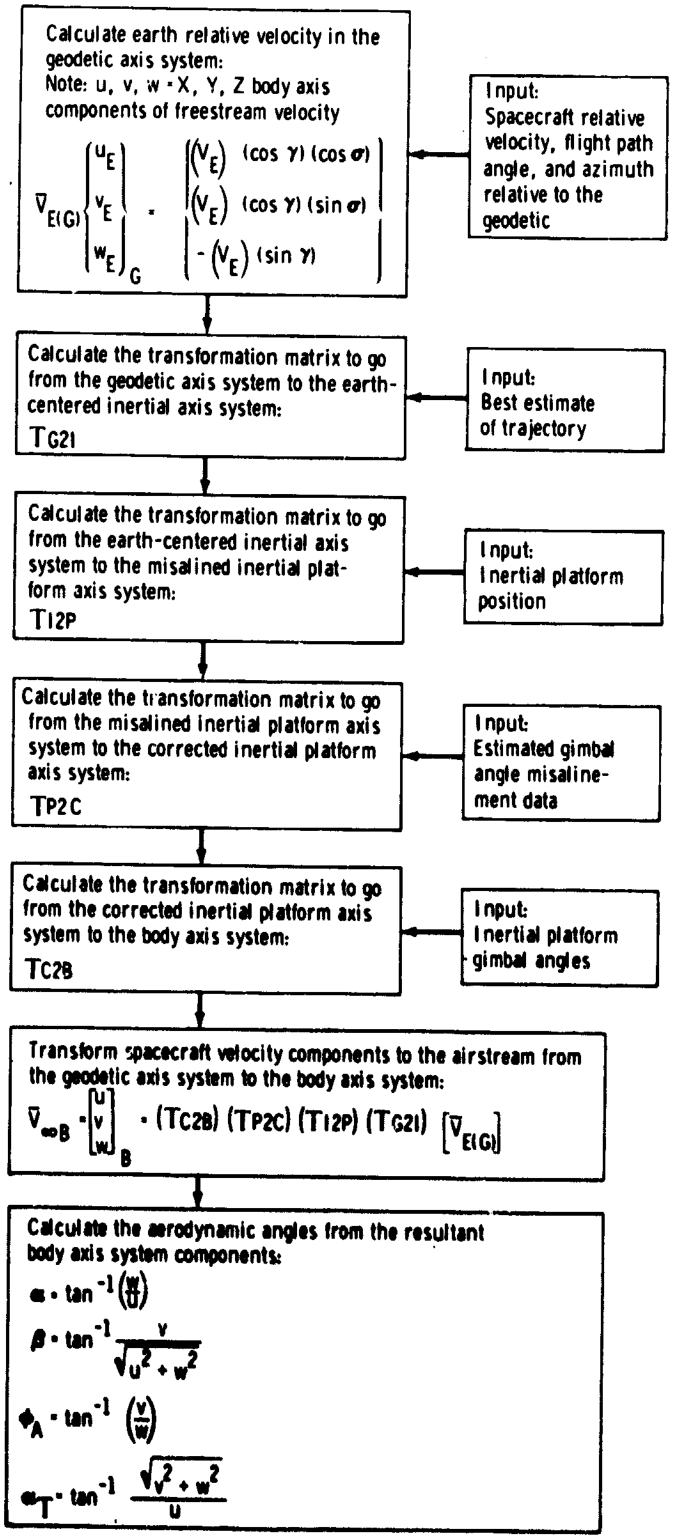

Figure 8. - Aerodynamic angle program flow diagram.

Transform the IMU platform accelerations A_X, A_Y, and A_Z to the body relative accelerations A_A, A_N, and A_Y

Input:
IMU accelerations

Calculate the force coefficients relative to the body axes based on IMU or body-mounted accelerometer data

Note: V = velocity, W = spacecraft weight, S = aerodynamic reference area

$$C_{A_i} = \frac{(W)\left(A_{A_i}\right)}{(1/2)(\rho_\infty)\left(V_\infty^{\,2}\right)(S)}$$

$$C_{N_i} = \frac{(W)\left(A_{N_i}\right)}{(1/2)(\rho_\infty)\left(V_\infty^{\,2}\right)(S)}$$

$$C_{Y_i} = \frac{(W)\left(A_{Y_i}\right)}{(1/2)(\rho_\infty)\left(V_\infty^{\,2}\right)(S)}$$

$$C_{NR_i} = \sqrt{C_{Y_i}^{\,2} + C_{N_i}^{\,2}}$$

where i is IMU or body-mounted accelerometer data

Input:
Air density determined from either sounding rocket data or axial-force equation using flight data V, W, and S.

Calculate lift and drag force coefficients:

$$C_{L_i} = \left(C_{NR_i}\right)\left(\cos \alpha_T\right) + \left(C_{A_i}\right)\left(\sin \alpha_T\right)$$

$$C_{D_i} = \left(C_{NR_i}\right)\left(\sin \alpha_T\right) - \left(C_{A_i}\right)\left(\cos \alpha_T\right)$$

Then calculate lift-to-drag ratio:

$$L/D_i = C_{L_i} \Big/ C_{D_i}$$

Input:
Flight total angle of attack

Figure 9. - Force coefficient program flow diagram.

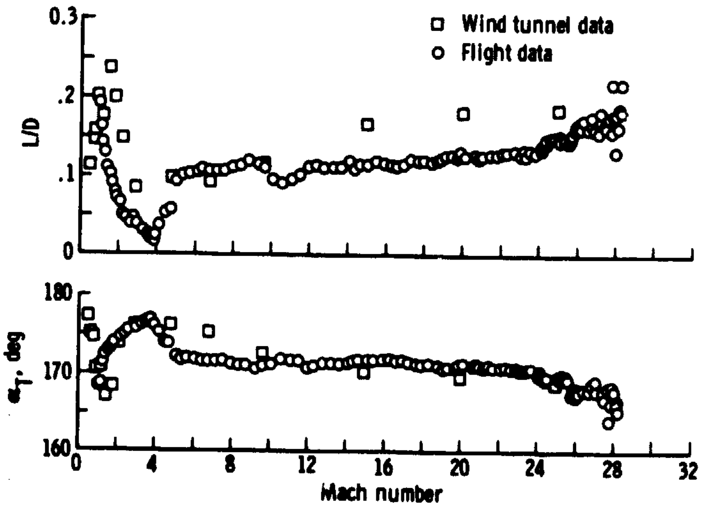

Figure 10. - Comparison of flight-modified wind tunnel aerodynamic data (α_T and L/D) with Gemini V flight aerodynamic data.

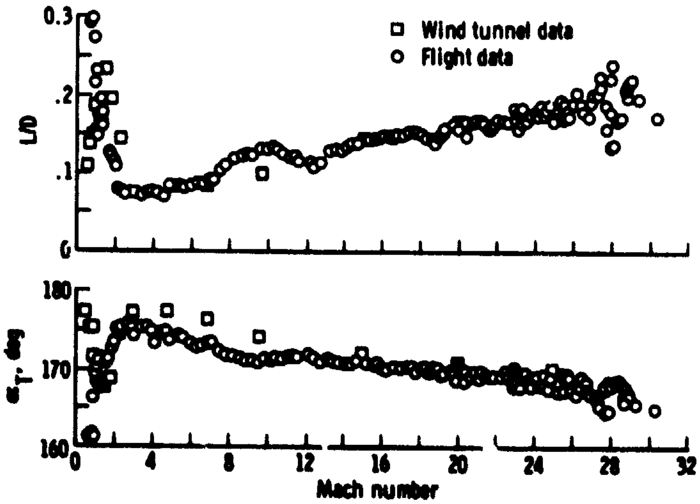

Figure 11. - Comparison of flight-modified wind tunnel aerodynamic data (α_T and L/D) with Gemini VIII flight aerodynamic data.

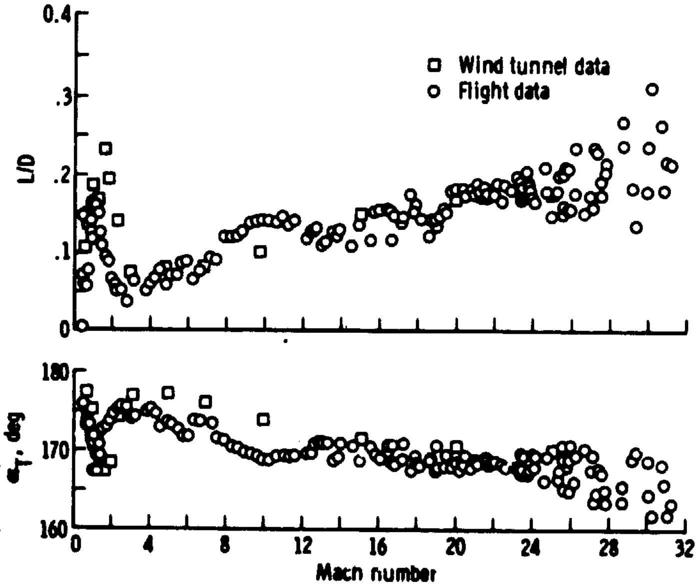

Figure 12. - Comparison of flight-modified wind tunnel aerodynamic data (α_T and L/D) with Gemini X flight aerodynamic data.

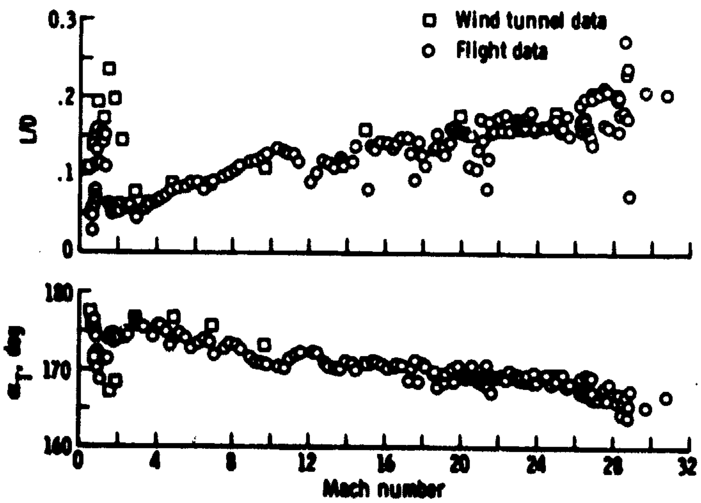

Figure 13. - Comparison of flight-modified wind tunnel aerodynamic data (α_T and L/D) with Gemini XI flight aerodynamic data.

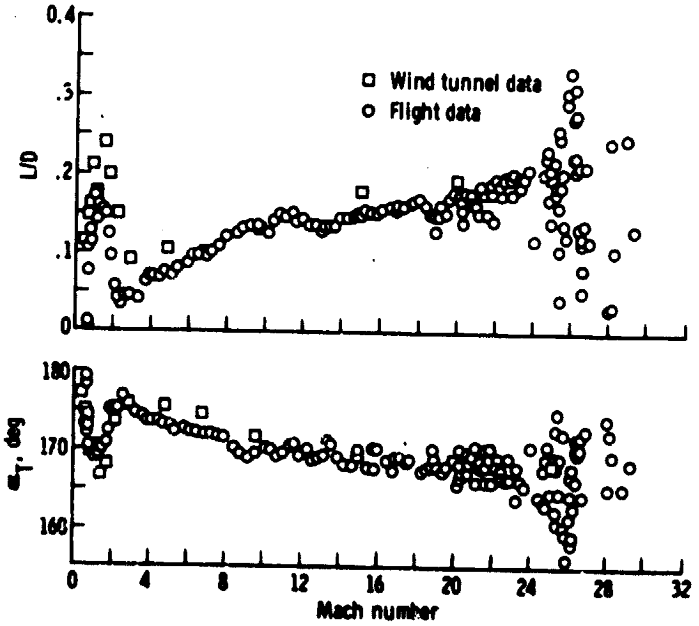

Figure 14. - Comparison of flight-modified wind tunnel aerodynamic data (α_T and L/D) with Gemini XII flight aerodynamic data.

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